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The Engineer

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World Power Conference.

The British Empire Exhibition (Eleventh Notice).

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A Decade's Progress in Marine Propulsion.

Short-wave Directional Wireless.

Indicating High Speed Engines.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES—

"GALVANISED IRON TELEGRAPH WIRE.

Tenders due on the 25th July, 1924.

Tender forms obtainable from above. 6315

85ft. Span Girder Bridge. TENDERS are INVITED for the IRONWORK ONLY of the above dismantled BRIDGE. Approximate weight, 52 tons 15 cwt. The bridge and specifications can be seen at SCHOOL OF MILITARY ENGINEERING, Chatham. Tender forms can also be obtained therefrom. 6265

Assistant Engineers Required by the GOVERNMENT of the GOLD COAST for preliminary investigation and survey work in connection with the proposed Coomassie Waterworks for a tour of 12 to 18 months' service, with possible extension. Salary £480 a year for the first three years of service, then, if taken on the permanent staff £510, rising to £720 a year by annual increments of £30, and thereafter to £920 a year by annual increments of £40. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, age 22 to 35, should be Students or Associate Members of the Institution of Civil Engineers or of the Institution of Water Engineers, should be thoroughly practical Surveyors and have been trained under a Waterworks Engineer of standing, and have had experience in the Design and Construction of Reinforced Concrete Dams, Filter Works, &c.—Apply at once by letter, stating age and giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting at the top of application M/12,684. 6294

Assistants (Three) Required by the GOVERNMENT of HONG KONG for service in the Architectural Office of the PUBLIC WORKS DEPARTMENT, for a period of three years, with possible permanency. Salary £466, rising by annual increments of £30 to £500 a year, and thence (if appointment is made permanent) to £930 a year, payable locally in dollars at the Government rate of exchange, which is at present fixed at 2s. to the dollar. In addition a strictly temporary exchange allowance of 20 per cent. of salary is at present paid. Candidates, unmarried, 24 to 32 years of age, must be duly qualified architects' assistants and associates of the R.I.B.A., should be experienced in design and the preparation of working drawings, details and specifications, and have some knowledge of quantities. Experience in the design and erection of steel-framed buildings and a working knowledge of reinforced concrete is desirable.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/12,919. 6320

Assistants with Technical training to the standard of B.Sc., degree and Works and Drawing-office experience, are REQUIRED at the Royal Aircraft Establishment, South Farnborough, Hants.

A-30.—For the Airworthiness Department in connection with Checking by Calculation the Strength and Aerodynamic Characteristics of Aeroplanes. One with special proficiency in Mathematics is required, and one with good knowledge of technical French.

A-31.—For the Mechanical Testing Department, for Tests and Experimental Work on Strength of Materials and Aircraft Components.

Starting salary about £6 per week, plus Civil Service bonus, giving present total of 97s. p.w. Ex-Service men preferred.

Apply, quoting the above reference numbers, to SUPERINTENDENT, R.A.E., South Farnborough, Hants. 6266

Civil Engineers (4) Required by the GOVERNMENT of CEYLON for appointment as Irrigation Engineers for three years in the first instance. Salary, £500, rising to £900 a year by annual increments of £40 (£800 on attaining 30 years of age). Free passage provided. Candidates, 26 to 31 years of age, unmarried, must have had war service and passed the examinations to qualify for Associate Membership of the Institution of Civil Engineers, or hold equivalent professional qualifications, and have had at least three years' practical experience on Waterworks, Drainage, or Harbour and Dock Works.—Apply at once, in writing, giving age and brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting at head of application M/12,653. 6260

Draughtsman Required for the Engineering Department of the GOLD COAST GOVERNMENT RAILWAY, for two tours of 12 to 18 months' service. Salary, £490, rising to £450 a year by annual increments of £15, thence to £450 by one annual increment of £20 and thence to £720 by annual increments of £30. Free quarters and passages. Outfit allowance of £60 on first appointment. Liberal leave at home on full salary. Candidates, age 26 to 33, preferably single, must have been articled for at least three years to a recognised firm of Architects or Civil Engineers, and have had some practical experience in Building Construction. Must be able to take out quantities and prepare estimates. Must be neat Draughtsmen, be able to Calculate Stresses in Simple Structures, and get out Designs for Buildings of a simple character, either of wood, concrete or steel.—Apply at once, in writing, stating age, and giving brief details of experience and qualifications and stating whether married or single, quoting clearly at head of application M/12,915. 6295

East Indian Railway.

The Directors are prepared to receive up to 11 a.m. on the 16th July instant TENDERS for the SUPPLY of:—

(1) WHEELS AND AXLES.

(2) STEEL TYRES FOR LOCOMOTIVES.

Copies of the specifications can be obtained at the Company's Offices on payment of £1 1s. each. This fee will not be returned.

G. E. LILLIE, Secretary.

73/76, King William-street, London, E.C.4.
3rd July, 1924. 6319

PUBLIC NOTICES

University of Liverpool.

SESSION 1924-1925.

FACULTY OF ENGINEERING.

DEAN: Professor T. B. ABELL, O.B.E., M.Eng., R.C.N.C. Ret., M. Inst. N.A.

Prospectus and full particulars of the following may be obtained on application to the REGISTRAR:—Engineering, Thermodynamics of Heat Engines, Strength of Materials, Electrical Engineering, Civil Engineering, Naval Architecture, Marine Engineering, Metallurgy, Geology, Design and Drawing, Refrigeration, Mathematics, Physics, Chemistry. 6229

Northampton Polytechnic Institute, CLERKENWELL, LONDON, E.C. 1.

The Governing Body invite APPLICATIONS for the APPOINTMENT of PRINCIPAL of the Northampton Polytechnic Institute from University Graduates or persons of equivalent standing, familiar with the Training of Engineers. In addition to Mechanical, Civil, Electrical and Optical Engineering (with a four-year day course of University Grade), the curriculum includes Technical Chemistry, Horology and Women's Subjects. There is a social side, with recreation ground, swimming bath, gymnasium, choir, orchestra, &c. The Principal will be the responsible Head and must be experienced in administrative organisation.

The initial salary sanctioned by the Education Authority is £1250, and, in common with all teachers' salaries on the Burnham Scale, is subject to an abatement at present of 5 per cent., and to deductions under the School Teachers (Superannuation) Acts.

Particulars of the duties and conditions of the appointment may be obtained by writing to the undersigned, to whom applications on special forms must be returned not later than July 12th.

It is desirable that the selected candidate should take up his duties early in September, 1924.

W. K. DAVIS, Clerk to the Governing Body.

6263

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for ONE 40-Ton STEAM WRECKING CRANE.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, E.C. 2, on or after 30th June, 1924.

A fee of 20s. will be charged for the specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Thursday, 10th July, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
R. C. VOLKERS, Secretary.

6242

Bombay, Baroda, and Central India Railway Company.

The Directors are prepared to receive up to Noon on Wednesday, 16th July, TENDERS for the SUPPLY of—

1. SCREW COUPLINGS.
2. PLATE and SHEET GLASS, &c.
3. TYRES for CARRIAGES and WAGONS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG, Secretary.

Offices: 91, Petty France, Westminster, S.W. 1. 6283

PUBLIC NOTICES

Borough of Richmond (Surrey). WATER DEPARTMENT.

TENDERS FOR 9in. AND 7in. DIAMETER C.I. PIPE LINE, &c.

The Town Council of Richmond are prepared to receive TENDERS for the LAYING and JOINTING of approximately 750 Yards 9in. dia. and 340 Yards of 7in. dia. CAST IRON PIPES, with the necessary Specials, Valves, &c.

Copies of the conditions of contract, specification and form of Tender may be obtained from Mr. H. P. Williamson, M. Inst. C.E., Water Engineer, Riverside, Richmond, Surrey, upon payment of £2 (by cheque), which will be returned on receipt of a bona fide Tender and the return of all documents supplied.

Tenders on the forms supplied, enclosed in sealed envelopes and endorsed "Tender for 9in. dia. Main," must be delivered at the office of the undersigned not later than 10 a.m. on Monday, the 21st July, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

HENRY SAGAR, Town Clerk.

Town Hall,
Richmond, Surrey.
25th June, 1924. 6188

County of London. BELL WHARF OUTLET, SHADWELL.

The London County Council invites TENDERS for the CONSTRUCTION of a 4ft. diameter SEWER in Brick and Concrete, of a total length of about 200ft., with Weir Chamber and Tumbling Bay, in the Metropolitan Borough of Stepney, in the Administrative County of London.

Persons desiring to submit Tenders may obtain the drawing, specification, form of Tender, &c., on application, on or after Monday, 7th July, to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £5 by charge or draft to the order of the London County Council. This amount shall be returnable only if the tenderer shall have sent in a bona fide Tender, and shall not have withdrawn the same. Full particulars of the work may be obtained upon personal application, and the contract documents may be inspected at the Old County Hall before the payment of £5 fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m., on Monday, 28th July, 1924, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD, Clerk of the London County Council.

6232

Tyne Improvement Commission. ELECTRIC MOTORS AND ACCESSORIES.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the SUPPLY and DELIVERY of ONE 20 H.P. and THREE 3 H.P. D.C. ELECTRIC MOTORS for the Albert Edward Dock, Percy Main, North Shields.

Copies of the form of Tender and specification may be obtained on application to the undersigned.

Tenders, in sealed envelopes, endorsed on the cover "Tender for Electric Motors and Accessories," must be delivered at the undermentioned offices, addressed to "The Chairman of the Docks Committee, Tyne Improvement Commission," not later than Noon on Saturday, the 12th day of July, 1924.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
ALBERT BLACKLOCK, Secretary.

Tyne Improvement Commission Offices,
Bewick-street,
Newcastle-upon-Tyne,
27th June, 1924. 6230

PUBLIC NOTICES

Metropolitan Water Board. DISPOSAL OF WROUGHT IRON BOILERS (OLD AND DISUSED).

The Metropolitan Water Board invite TENDERS for the PURCHASE and REMOVAL of SIX OLD DISUSED CORNISH BOILERS, situate at their works at Lea Bridge, Clapton.

These boilers may be seen at the above-mentioned works at any time between 9 a.m. and 4 p.m. on week-days (Saturdays excepted), on application to the Engineer-in-charge.

Forms of Tender and conditions of contract may be obtained on and after 3rd July, 1924, from the Chief Engineer, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1, by personal application (Room 155) or upon forwarding a stamped addressed envelope.

Tenders must be on the official forms enclosed in sealed envelopes, addressed to the Clerk of the Board, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1, endorsed "Tender for Boilers, Lea Bridge," and delivered at the offices of the Board not later than 11 a.m. on Monday, 14th July, 1924.

The Board do not bind themselves to accept the highest or any Tender.

C. F. STRINGER, Clerk of the Board.

Offices of the Board,
New River Head,
173, Rosebery-avenue, E.C. 1.
30th June, 1924. 6290

The Great Indian Peninsula Railway Company, 48, Copthall-avenue, London, E.C. 2, invite TENDERS for—

1. FENCING WIRE STRAND ..... Fee 10s.

Tenders are due by 11 a.m. on 15th July, 1924. Tender forms obtainable at above address. Fees not returnable. 6311

In the High Court of Justice (Companies Winding Up).

To be Offered for Sale by TENDER, pursuant to an Order of the Registrar Companies (Winding Up), made in the matter of ALLEN and SIMMONDS (READING), Ltd., Branch Nominees, Ltd., v. Allen and Simmonds (Reading), Ltd., 1922 A., No. 2696, either in ONE LOT as a GOING CONCERN or in the following LOTS:—

LOT 1.

(a) A FREEHOLD GARAGE, SHOWROOMS and OFFICES, situate in the centre of READING, with frontages to Friar-street and Station-road, and containing an area of about 23,000 square feet, together with the ASSETS and the BUSINESS carried on on such premises, and the whole of the SHARE CAPITAL and DEBENTURES in GREAT WESTERN MOTORS, Ltd.

(b) A BLOCK of TEN FREEHOLD COTTAGES adjoining the above.

(c) A FREEHOLD FACTORY at Vastern-road, READING, with Modern Buildings thereon, covering an area of about 14,500 square feet, at present let as a Motor Body Building Works, in connection with the aforesaid business.

LOT 2.

(a) A LEASEHOLD ENGINEERING WORKS at READING, containing a total floor space of about 27,000 square feet, held for an unexpired term of 57 years at ground rents amounting to £77 6s. per annum. These Works are equipped with high-class ENGINEERS' MACHINE TOOLS for the manufacture of Piston Rings and other Specialities of the Company.

(b) THIRTY LEASEHOLD COTTAGES and a RESIDENCE adjoining, held for a similar period at nominal ground rents.

(c) LEASEHOLD PREMISES, suitable for Garages, situate No. 107, Caversham-road, READING, held for an unexpired term of 61 years.

(d) A FREEHOLD PROPERTY on the THAMES at CAVERSHAM, adjoining the Bridge, formerly a Club, but now let off in self-contained Flats.

(e) A FREEHOLD HOUSE, No. 18, King's Meadow-road, READING.

(f) THE GOODWILL of the BUSINESS of ALLEN and SIMMONDS (READING), Ltd., as a GOING CONCERN and LETTERS PATENT for "improvements in the Manufacture of Piston Rings, &c."

LOT 3.

3000 £1 FULLY PAID SHARES, GREAT WESTERN HOTEL (READING), Ltd.

25 £1 FULLY PAID DEFERRED ORDINARY SHARES, and

4500 £1 FULLY PAID PARTICIPATING PREFERRED ORDINARY SHARES in the READING FOUNDRY CO., Ltd.

Tenders, which must be on the form contained in the particulars, are to be sent to the Registrar, Companies (Winding Up), Room 48, Bankruptcy-buildings, Carey-street, W.C. 1, and marked "Tender re Allen and Simmonds (Reading), Ltd.," and delivered under seal by Twelve Noon on or before Saturday, 19th July, 1924.

Particulars, with plan, form of Tender, and conditions of sale, may be had of Messrs. W. B. PEAT and CO., Chartered Accountants, 11, Ironmonger-lane, London, E.C. 2; Messrs. WILDE, WIGSTON and SAPTE, Solicitors, 21, College-hill, London, E.C. 4; and of Messrs. PEACOCK and GODDARD, of 3, South-square, Gray's Inn, London, W.C. 1. 6046

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PUBLIC NOTICES

County Borough of Wolverhampton.

DEPUTY WATER ENGINEER.

The Council are prepared to receive APPLICATIONS from qualified Engineers for the above POSITION, for which a salary and bonus of £400 per annum will be paid, advancing by two annual increments of £25, subject to satisfactory service.

The Council having adopted the Local Government and other Officers' Superannuation Act, 1923, the appointment will be subject to percentage deductions in accordance with the provisions of the Act.

Applications, stating age, experience, qualifications and present salary, together with copies of three recent testimonials, must be delivered to my office before Noon on Friday, the 18th inst.

Canvassing members of the Council personally or otherwise will disqualify applicants.

(Sgd.) E. A. B. WOODWARD,
Water Engineer and Manager.

Town Hall,
Wolverhampton.
2nd July, 1924. 6310

Durham County Water Board.

APPLICATIONS are INVITED for the APPOINTMENT of ASSISTANT WATER ENGINEER.

Candidates must be properly qualified engineers, from 30 to 40 years of age, have had practical experience in the construction and maintenance of distribution works and the control of workmen. The successful candidate will be required to devote the whole of his time to the service of the Board.

Preference will be given to associate members of the Institution of Civil Engineers.

Commencing salary £400 per annum.

Applications, stating age, qualifications and experience, with copies of three recent testimonials, to be sent to the undersigned not later than Tuesday, July 8th.

Canvassing will disqualify.

HENRY ROBINSON,
Engineer to the Board.

Bishop Auckland, Co. Durham,
25th June, 1924. 6189

SITUATIONS OPEN

WANTED, a WORKS CHEMIST for Test House and Metallography Work. Experience and wages required.—Address, 6294, The Engineer Office. 6294 A

WANTED, Experienced Practical MAINTENANCE ENGINEER for South Country Factory. Chiefly heavy type milling machinery, steam and electric power.—Address, stating experience, qualifications, and salary required, 6277, The Engineer Office. 6277 A

WANTED, MANAGER for Cold Rolled Strip Steel Mill in the Midlands; must be fully experienced in processes and able to obtain high-quality production cheaply. State age, experience, salary required and when at liberty.—Address, 6304, The Engineer Office. 6304 A

ASSISTANT WORKS MANAGER WANTED in established Engineering Works, Midland District, manufacturing Steam, Oil, and Gas Engines, also Pumps; 2000 employed. This is a really good opening with plenty of scope for a sound practical progressive man of strong character and ability. A knowledge of modern workshop methods and organisation is essential. Age about 35. Write, stating experience, age, and salary required. All applications will be treated in confidence.—Address, 6313, The Engineer Office. 6313 A

BREWERY CONSULTING ENGINEER. About 30 years of age, WANTED for large West of England Company; must have good knowledge and experience of Brewery Plant and Engineering, and be capable of drawing up specifications for all brewing and bottling plant, &c. Commencing salary £600 to £700 per annum.—Address, stating qualifications, training, and details of present occupation, 6248, The Engineer Office. 6248 A

CHIEF ASSISTANT to SALES MANAGER REQUIRED for leading firm of Internal Combustion Engineers. Good connection in engineering circles desirable. Sound commercial ability and intimate knowledge of mechanical, electrical and marine work necessary. Applications treated as strictly confidential.—Address, 6258, The Engineer Office. 6258 A

EMPLOYERS REQUIRING Reliable EX-NAVAL MEN for Charge of Machinery, Steam Trial Parties, &c., should write to the NATIONAL ASSOCIATION for EMPLOYMENT of REGULAR SAILORS, SOLDIERS and AIRMEN, Room 6, Dock-road, Chatham. Telephone, Chatham 10. P9274 A

ENGINEERS' AGENTS, &c., Established W.C., REQUIRE qualified ENGINEER to replace retired partner. Small capital sufficient, but must have energy, initiative, and some business connection.—Address, P9272, The Engineer Office. P9272 A

ENGINEER REQUIRED for Reinforced Concrete Work in Malay States. Age 26/30, single; must be capable calculating strains and supervising actual contracts. Engagement guaranteed 3 months, with possible permanency for right man. Passage paid both ways.—Apply by letter, giving qualifications, to "WATER TOWER," 36, Basinghall-street, E.C. 2. 6259 A

ENGINEER SALESMAN REQUIRED for London and South of England. Must have thorough knowledge of modern Crane practice. Good sales record essential. Give full particulars of experience, age, and salary required.—Address, 6306, The Engineer Office. 6306 A

ENGINEERING and FOUNDRY MANAGER. Experienced in modern production of high-class general and repetition work, capable organiser. State qualifications fully, age, references, salary expected.—Address, P9295, The Engineer Office. P9295 A

MACHINE SHOP MANAGER REQUIRED by London firm of Mechanical Engineers, to run machine shop containing 150 machines on non-repetition work. Experience in similar post essential. Salary £350, rising to £450, and good prospects.—Address, 6247, The Engineer Office. 6247 A

MECHANICAL ENGINEER REQUIRED for Service in Africa; Gas and Steam Engine experience. Maintenance Small Plants. Erection Steel Buildings, able to keep accounts. Tour 30 months, leave 6 months, housing, medical attendance, free passages. Salary £275-£300 per annum.—Address applications, 6113, The Engineer Office. 6113 A

REPRESENTATIVES' ASSISTANT REQUIRED for Constructional Engineering. Must have intimate knowledge Constructional Work in London markets, chiefly amongst export houses. State full particulars, salary, references in confidence.—Box 6, Brook's Publicity Service, 58, Chancery-lane, W.C. 2. P9304 A

REQUIRED for the Sales Department of an Old-established Firm of Engineering Makers, a qualified ASSISTANT, with engineering knowledge and experience in technical quotations. Must be alert and industrious and capable of following up business.—Write qualifications to 6317, The Engineer Office. 6317 A

REQUIRED IMMEDIATELY, REINFORCED CONCRETE ENGINEER, accustomed to the design of all classes of structures; must have had considerable outside experience of such works.—Reply, giving full particulars and salary required, to F. C. CONSTRUCTION COMPANY, Ltd., 26, Iron Gate, Derby. 6307 A

SITUATIONS OPEN (continued)

WANTED, Experienced DRAUGHTSMAN for Power Station Pipe Work, arrangement and detail, capable of taking own measurements on site.—Address, stating salary required, and giving particulars as regards experience, 6276, The Engineer Office. 6276 A

WANTED, Experienced DRAUGHTSMAN, Modern Steam Engine Practice and General Work. State age, experience, salary required.—Address, 6251, The Engineer Office. 6251 A

WANTED IMMEDIATELY in Westminster, DRAUGHTSMAN, accustomed to quantities and details in connection with Steel Structural Engineering; good opportunity for gaining experience. State age, experience and salary required.—Address, 6293, The Engineer Office. 6293 A

ASSISTANT DRAUGHTSMAN WANTED, with experience in Design of Boilers, Tanks, Steel Chimneys, &c. Applicants to state age, experience, and wages required.—Apply by letter, H. and T. DANKS (Netherton), Ltd., Netherton, Dudley. 6253 A

A WELL-ESTABLISHED FIRM, Specialising in the manufacture of Mechanical Handling Plants on a large scale for coal, coke, ash, &c., REQUIRES a CHIEF DRAUGHTSMAN AT ONCE. Gas and Electricity Works knowledge desirable. Only first-class and up-to-date men, with real organising ability, need apply. State age, salary, &c.—Address, 6238, The Engineer Office. 6238 A

AN Experienced DESIGNER of TURBO-COMPRESSORS REQUIRED, to Take Charge of Turbo Department.—Applicants should give details of career, qualifications, and salary desired to REAVELL and CO., Ranelagh Works, Ipswich. 6269 A

BRIDGE DRAUGHTSMAN REQUIRED: One with Swing Bridge experience preferred.—Address, stating age, experience, and salary required, 6280, The Engineer Office. 6280 A

DRAWING-OFFICE. Expert CHECKER. Medium light machinery, thoroughly experienced production engineer with proved successful experience checking and controlling check of designs for economical manufacture and assembly. Permanency and high pay for efficiency.—Write, Box 136, c/o Hooper and Batty, Ltd., 15, Walbrook, E.C. 4. 6316 A

DRAUGHTSMAN for London (Designing and Estimating), thoroughly experienced in Lay-out of Mechanical Gas Producer Plant and General Structural Work.—Address, stating age, experience, and salary, 6285, The Engineer Office. 6285 A

DRAUGHTSMAN REQUIRED, Engineering Firm in City, used to Piping Lay-outs. Only experienced man need apply, stating age, experience, and salary required.—Address, 6312, The Engineer Office. 6312 A

DRAUGHTSMAN REQUIRED for Work in London with large firm of mechanical engineers; must be thoroughly experienced in Belt Conveyor Work, handling all materials.—Address, stating age, experience, and salary required, 6136, The Engineer Office. 6136 A

DRAUGHTSMAN, SENIOR, Mechanical-Electrical, WANTED, with first-class experience of Large A.C. and D.C. Machines, Midlands Works.—Address stating age, qualifications, experience, and salary, 6141, The Engineer Office. 6141 A

DRAUGHTSMAN, Thoroughly Experienced in the Design and Construction of Dock Gates and Caissons, first-class man, WANTED. Must be expert in the design and preparation of all calculations for this class of work. State age, experience, and salary expected.—Address, 6243, The Engineer Office. 6243 A

DRAUGHTSMAN WANTED by Firm in the Midlands manufacturing Municipal Vehicles. Applicants should state age, experience, and salary required and enclose copies of references.—Address, P9283, The Engineer Office. P9283 A

DRAUGHTSMAN WANTED, Used to Structural Steel Work and Lay-outs of Machinery. Must be quick and accurate. Permanent position for suitable man. State age, experience, and salary required. —Address, 6236, The Engineer Office. 6236 A

EXPERIENCED DRAUGHTSMAN, with Knowledge of Pumping Plant, Buildings, Pipe Lines, &c., REQUIRED in Water Engineer's Office. A salary of four guineas per week will be paid.—Applications, stating age, training, qualifications, and experience, must be received by me not later than Friday, the 18th inst.—E. A. B. WOODWARD, Water Engineer and Manager, Wolverhampton. 6309 A

FIRST-CLASS STRUCTURAL DRAUGHTSMEN REQUIRED, for North-East Coast. Must have had experience on Heavy Bridge Work, Foundations, Buildings, &c.; designing, preparing drawings for shops and estimating. State salary required. Others need not apply.—Address, 6305, The Engineer Office. 6305 A

HEAD DRAUGHTSMAN REQUIRED AT ONCE. Must have had all-round experience in design of High-speed Electric Goods and Passenger Lifts and be capable of organising drawing-office on systematic lines. Splendid opportunity for progressive and permanent position for the right man.—Applications only desired from really first-class men, who should state full particulars of experience and salary required, to E. A. EVANS, Ltd., Lift Engineers, Prospect-road, Leicester. 6249 A

JUNIOR DRAUGHTSMAN REQUIRED, Fire-resisting Floors and Constructional Engineers' Office. State experience and salary required.—Write to HOMAN and RODGERS, Ltd., 17, Gracechurch-street, E.C. 2. 6292 A

JUNIOR DRAUGHTSMAN REQUIRED, Preferably one who has had a few years' experience either on Lift or Crane Work. Good opening for really energetic and able junior who wishes to improve his position.—Full particulars of experience and salary required should be addressed to E. A. EVANS, Ltd., Lift Engineers, Prospect-road, Leicester. 6250 A

LEADING DRAUGHTSMAN REQUIRED for Design of Paraffin and Semi-Diesel Marine Motors. Must have had thorough training and experience.—Address, stating age, details of experience and salary required, &c., H. W. BAMBER, 166, Piccadilly, London, W. 1. 6285 A

MESSRS. DORMAN, LONG and CO., Ltd., Middlesbrough, REQUIRE ONE or TWO capable DRAUGHTSMEN, thoroughly experienced in Designing and Detailing Constructional Steel Work for all kinds of Steel-frame Buildings, &c. Only first-class men need apply.—Letters, stating age, experience, and salary required, to be addressed to MANAGER, Messrs. Dorman, Long and Co., Ltd., Constructional Department, Middlesbrough. 6281 A

PUMPING MACHINERY. — DRAUGHTSMAN WANTED, capable of designing and calculating. State experience, age, and salary required.—Address 6022, The Engineer Office. 6022 A

STRUCTURAL DRAUGHTSMAN. Good Experience in Designing Steel Work to L.C.C. requirements. State experience and salary expected.—Address, P9282, The Engineer Office. P9282 A

WANTED, a First-class FOUNDRY FOREMAN in the Midlands, accustomed to making Castings in Green Sand, Dry Sand and Loam up to 10 tons in weight.—Address, stating age, experience and salary required, 6252, The Engineer Office. 6252 A

FOREMAN REQD. for Assembly Dept. Large works, London, producing Motor Car Clocks. Must be technically efficient on instrument making generally, first-class organiser, and capable controlling large staff female operators.—Address, P9269, The Engineer Office. P9269 A

SITUATIONS OPEN (continued)

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DRAUGHTSMAN, Mechanical, Age 30, SEEKS ENGAGEMENT (London preferred); 6 years shops, 8 years drawing-office.—H. W. OSBORNE, 27, Bath-road, Dartford. P9293 B

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For continuation of Small Advertisements see page 3.

Bagshaw's Wrought Iron Pulleys, as used in Government Departments, are the strongest, cheapest and best in the market. Quick delivery given. Also FRICTION CLUTCHES for all purposes, SHAFTING, WHEELS and PEDESTALS. List free.—J. BAGSHAW and SONS, Ltd., Engineers, Batley, Yorkshire.

JULY 4, 1924.—VOL. CXXXVIII.

THE ENGINEER.

A Seven-Day Journal

The London County Council Tramways.

A BRIEF summary of the accounts of the working of the London County Council's tramways for the year ended March 31st last, and an estimate of what will be the result of working during the current year, have now been published. They neither of them give cause for rejoicing. The net result of working during the past year was a loss of £160,222 7s. 5d.; the estimated result of this year's working is a loss of £316,276. The loss of £160,222 7s. 5d. has been made good from the Reserve Fund, which now stands at only £40,604 11s. 1d. Supposing the estimated deficit of £316,276 to be correct, and supposing the remainder of the Reserve Fund to be employed in reducing it, an extinguished Reserve Fund and an adverse balance of over £275,000 are to be anticipated by the end of March next, and that amount will have to be made good out of the rates. It is a lamentable state of affairs, and it is made no better by the knowledge that, on so many occasions in the past, the Highways Committee of the Council has been too optimistic in its estimates, so that there is no certain feeling that the anticipated deficit of £316,276 will not be exceeded. It is only too true, unfortunately, that up till the 18th of this month over 1,900,000 fewer passengers had been carried than during the same period last year, and that the receipts were over £95,000 less. The income for the year 1923–24 was £4,374,057. The estimated income for the present year is £4,509,500. or £135,443 more than last year. If the receipts are already—in less than three months—down by over £95,000, how much chance is there of an increased revenue over the entire year? The only gleam of hope is afforded by the fact that, in the preparation of the estimate for the current year, a lower figure for the receipts per car mile—15.75d., as compared with 16.04d. in 1923–24—and a higher figure for working expenses—14.35d., as compared with 13.17d.—have been taken.

A New Railway Signal.

THE display of railway signal indications by colours during the day, as well as at night, and in the open as well as underground, has now been in successful operation for three years on the Liverpool Overhead Railway, and for fifteen months between Marylebone and Wembley on the Great Central section, London and North-Eastern Railway. On the first named line there are no distant signals, and, therefore, the two indications of "stop" and "clear" only are necessary. The Great Central, as is usual on all high-speed railways, required a distant indication, and thus a yellow light for "caution" was added. The signals consequently are "three indication" signals, the "caution" indication repeating the condition of the next stop signal. Where the signalling sections are of fairly even length and the signals spaced at a nearly uniform distance apart, the distant indication can be at braking distance from the stop signal, but through station yards, where the sections vary in length and two stop signals may be within three or four hundred yards of each other, the "caution" indication does not afford full braking distance. To remedy this defect it has been proposed that in such short sections there shall be two yellow lights and, according as the driver sees both lights or one of them, will he know whether or not he has the full braking distance to the next stop signal. Such a signal has now been fixed at Southampton and was inspected on Saturday last by the members of the Institution of Railway Signal Engineers on the occasion of their summer meeting.

Re-casting a Railway Time-table.

A VERY interesting announcement is made by the Great Western Railway. The whole of its passenger train services are to be scrapped and on the 14th instant, coincident with the introduction of the summer service, all the main line trains and their branch connections are to be revised on a basis that will allow for greater use of the engine power and rolling stock. This economy will be effected by each set of vehicles, except those on long-distance trains, making a double trip a day. To obtain a sufficient interval at the end of the outward journey for the carriages to be swept, cleaned, &c., and for the engine duties to be carried out, an earlier start on the first trip or a later departure on the second may be necessary. Every train will have its own coaches, and they will be kept together and not, as now, "broken up" and re-made each day. All the vehicles will thus get the same wear and tear and the whole train will go into the shops for overhauling and re-painting when necessary. The re-casting of the time-table has allowed for the introduction of the practice, first adopted by the London and South-Western, of having standard departure hours for certain destinations, *e.g.*, from Paddington to Birmingham at ten minutes past the hour, and to South Wales at fifty-five minutes past, whilst trains for Paddington will leave Birmingham at the even hour and Cardiff at fifteen minutes past. There will be no increase in the overall speed and the same number of trains as in July, 1923, will be run. The net result, however, will be a saving of thirty-two locomotives and seventy-nine coaches.

New Naval Construction.

ON Friday last the Defence Equipment Bill was introduced by Mr. Bruce in the Australian House of Representatives. This Bill authorises, we learn, a grant of £2,000,000 for the construction of two 10,000-ton cruisers and £500,000 for a defence reserve fund. It is stated that one of these cruisers is to be built in Great Britain immediately, but in all probability the second cruiser will be built in Australia, even though the cost may be higher than it would be were it built in England. It is also understood that Mr. Massey, the Prime Minister of New Zealand, intends during the present session of Parliament to take up the question of the provision of an additional cruiser in connection with his expanded naval programme.

Lifeboat Flotilla on the Thames.

AN interesting ceremony took place on Tuesday afternoon when Admiral of the Fleet Sir Doveton Sturdee, Bart., G.C.B., inspected the flotilla of British and foreign lifeboats which is visiting the Thames in connection with the centenary celebrations of the Royal National Lifeboat Institution and the International Lifeboat Conference, referred to elsewhere in to-day's issue. Never before has such an interesting display of lifeboats been seen on the Thames. The British Lifeboat service, the oldest in the world, and the one upon which to a large extent others have been founded, was represented by the William and Kate Johnston of New Brighton, the most powerful motor lifeboat of the world, propelled by two of the Institution's 90 brake horse-power engines. She is a Barnett type twin-screw double-cabined boat 60ft. in length with a beam of 15ft. and a draught of 4ft. 7in. Another British boat was the William Archer of Teesmouth, a single screw Watson type cabin boat, 45ft. in length, with a beam of 12ft. 6in. and a draught of 4ft. Holland was represented by two boats, the Brandaris and the Prins der Nederland, the former being a twin-screw 60ft. motor boat with two single-cylinder Kromhout engines, and the latter a 55ft. steam lifeboat. The French Lifeboat Service sent its 36ft. twin-screw motor boat from the Calais station; while Denmark was represented by a 36ft. motor boat, Anholt Hayn, and Norway by a 50ft. life-saving ketch, Christian Bors, which accompanies the fishing fleets. One of the largest boats was the Justus A. Waller from Sweden, an auxiliary motor boat 62ft. in length, which is also fitted with a wireless installation. All the boats came to the Thames under their own motor and sail power, and were the centre of much public interest.

Southampton Floating Dock.

ON Friday last the Southern Railway Company's new floating dry dock, the largest dock of its kind in the world, was opened by the Prince of Wales. The levers in the control rooms for sinking the dock were operated by the Prince, and the large structure was slowly submerged to the required depth. During this operation luncheon was served on the Aquitania, and later the Prince was taken by steamer to the entrance of the submerged dock, where the ribbon stretched across the entrance was broken, and the dock was formally declared to be opened. Shortly afterwards the 19,000-ton liner the Arundel Castle, of the Union-Castle Mail Steamship Company, Limited, was berthed in the dock, and raised in a little over three hours. The new dry dock, it will be remembered, has an overall length of 960ft., a clear width of 130ft. 8in., and a total lifting power of 60,000 tons. It was constructed by Sir W. G. Armstrong, Whitworth and Co., Limited, to the designs of Messrs. Clark and Standfield, of Westminster, and was described in THE ENGINEER of October 20th, 1922, and February 22nd, 1924. Southampton now possesses docking accommodation for the largest ships using the port, and the initiative of the Southern Railway Company in providing such accommodation is to be warmly commended.

A New Industrial District for London.

IN a Journal note of April 4th we gave a brief account of the new scheme for a deep-water wharf with combined railway services which the Thames Land Company proposed to construct at West Thurrock, between Purfleet and Tilbury. On Monday last the Bill embodying this scheme was rejected by a committee of the House of Lords setting under the chairmanship of Lord Muir Mackenzie. After the committee had considered the Bill in private, the chairman stated that the committee felt that, however important the scheme might be, it could not get over the statutory provisions which gave to the Port Authority the jurisdiction to grant licences for, amongst other things, wharves within the area of the Port of London, with an appeal to the Ministry of Transport in case of refusal. Mr. Tyldesley Jones, K.C., representing the Port of London Authority, contended that if such a new statutory body as the proposed company were to be set up the whole principle of the constitution of the Port Authority would be violated, and that there would be established within its area a conflicting and competing body not subject to the jurisdiction of the Authority. It is understood that if a licence were granted by the Port Authority sanctioning any construction on the river banks, it would contain conditions restricting the use of such works to the private enterprise of those undertaking the construction. For the promoters of the Bill, Sir Lynden MacMassey, K.C., argued that it was not in the public interest that the scheme should be rejected because it was not possible in this case to comply with such a restriction.

The Channel Tunnel.

A FARTHER step in the promotion of the Channel Tunnel scheme was taken on Thursday of last week when the Prime Minister received a deputation on the subject from the House of Commons Channel Tunnel Committee. The deputation, it was stated, was supported by at least four hundred members of Parliament. The Prime Minister, after having heard the arguments advanced in favour of constructing the tunnel, admitted that the circumstances that had once been held to be against the scheme had changed within the last few years, and remarked that the whole question would have to be very carefully considered from a practical and detailed point of view. To that end he had summoned a special meeting of the Committee of Imperial Defence to consider and report upon the scheme to him. He himself proposed to take the chair at the Committee's meeting, and he had invited all the ex Premiers who had sat at any time on the Committee to attend. They had all accepted, so that it could be anticipated that the question would be considered entirely apart from any influence of party politics. It was announced on Wednesday evening that the Committee had reported against the construction of the tunnel.

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. XI.*

GENERAL ENGINEERING EXHIBITS.

W. H. ALLEN, SONS AND CO., LIMITED.

AMONGST the most attractive stands at Wembley is that of W. H. Allen, Sons and Co., Limited, of Bedford. All departments of the company's works have contributed to a display, which includes steam engines and turbines, condensing plant, pumps, oil engines, and various marine auxiliaries. A prominent exhibit is a Diesel engine of the Burmeister and Wain type, which the firm is now constructing under licence, for land and marine auxiliary use. A sectional drawing of the engine is given in Fig. 224. It is a four-cylinder land unit, and is designed for an output of 320 brake horse-power when running at 200 revolutions per minute. The cylinders are 410 mm., or nearly $16^3/_{16}$in., in diameter, with a stroke of 520 mm., or 20½in. It has forced lubrication to the main bearings, connecting-rods, and pistons. The crank shaft, including the fly-wheel seating and the outboard bearing journal, is made in one forging, and the cranks are drilled for main bearing and crank pin lubrication in the usual manner. The bed-plate is of heavy construction, and to it is bolted the crank case, the top of which is machined and bored out to take the main and the compressor cylinder casings. An interesting feature of the design is the manner in which the flanges of the cylinder jackets are secured to the crank case. The bottom flange of the casing is of box form, and is further strengthened by webs connecting it to the outer wall of the casing. Through this flange long bolts are passed, and are carried to the bottom part of the bed-plate, making a very rigid fastening. The cylinder liners are pressed into the jackets, and are supported at the bottom by an extended portion which is spigoted into the top of the crank case.

Trunk type pistons, with a ribbed oil-cooled piston head, are employed, and the cooling oil is supplied through telescopic pipes by a pump driven from the main crank shaft. The connecting-rods are made of mild steel, and the top end bearing is fitted with a solid bronze bush, while the bottom end bearing, which is adjustable, is steel, with a white metal lining. Each cover is provided with a fuel valve, air inlet valve, exhaust valve, and a starting valve. Of these valves, only the exhaust valve is water cooled, and its loose seat is designed in such a way that it can be easily renewed. The fuel valve opens inward, and gives a spray of oil in the form of a hollow cone, which shape, the makers claim, tends to promote good combustion and low fuel consumption. This type of nozzle also requires a minimum amount of attention and cleaning. Each cylinder is served by its own fuel pump. Air is used to inject the fuel into the cylinder and is provided by a three-stage compressor, mounted at the end of the engine, and driven from the main crank shaft. Large intercoolers are used and the air is cooled after each stage and after the final stage. The suction and delivery valves for each stage are made so that they are easily accessible. A spring-loaded governor is mounted on the top of the vertical shaft, and controls the fuel pumps direct. The usual type of vertical shaft and cam shaft drive is employed, and the cylinder valves are operated by overhead levers. All the engine controls are arranged at the governor end of the control platform, which platform also provides access to the fuel pumps and the mechanically operated lubricators which supply oil to the main cylinders and the air compressor. Engines of the type we have described are constructed for all kinds of land service, such as electric lighting and pumping, and also as main auxiliaries for motor ship work.

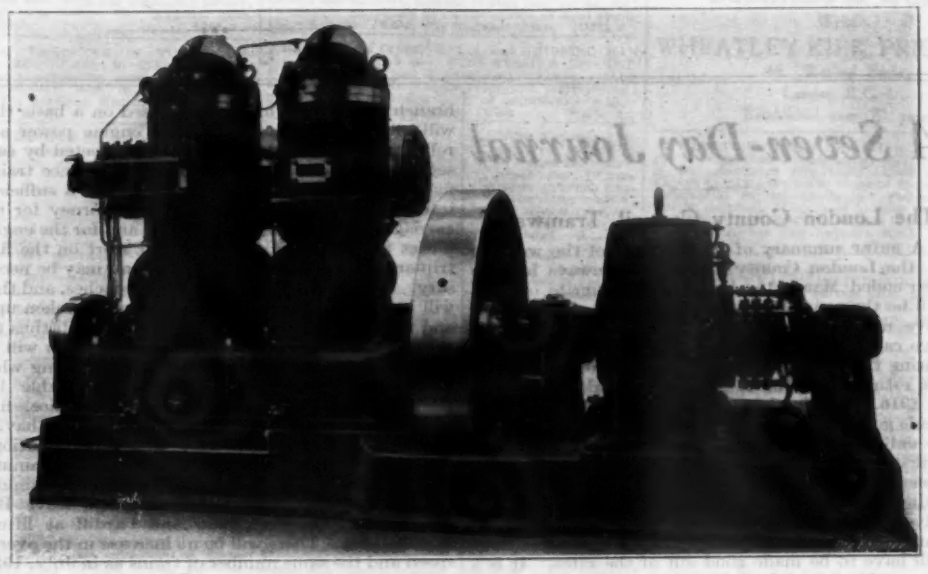


FIG. 225—36 K.W. EMERGENCY LIGHTING SET—ALLEN

Another type of oil engine made by the firm is used on the 36-kilowatt emergency lighting set, shown in Fig. 225. Similar generating units have

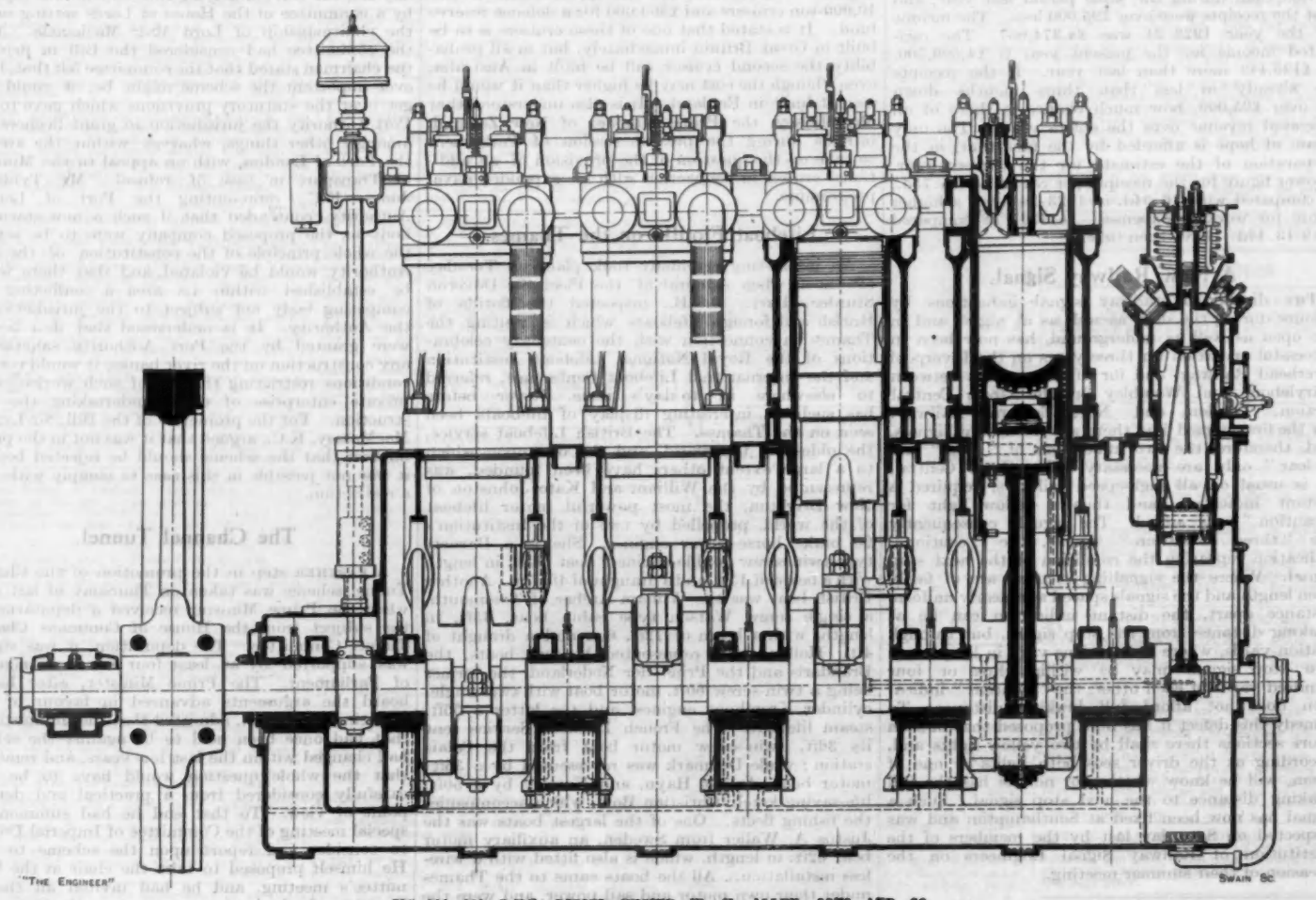


FIG. 224—320 B.H.P. DIESEL ENGINE—W. H. ALLEN, SONS AND CO.

* No. X. appeared June 27th.

been supplied to various liners and motor ships for emergency service. For such work, the engine and dynamo are placed in a special room at about boat deck level, and the set is connected electrically with the main switchboard. Should the main auxiliary generators fail, the emergency set can take over the lighting and pumping duties and maintain them, even though the main machinery spaces may be filled with water. The engine illustrated is of the hot-bulb two-cycle type, with two cylinders. It is rated at an output of 60 brake horse-power, when running at a speed of 325 revolutions per minute. It drives an Allen 36-kilowatt continuous-current 220-volt generator. The engine and dynamo are mounted on a combination bed-plate, and are coupled together by a solid coupling at the fly-wheel. Attention may be called to the ample proportions of the set. Particular care has been taken to ensure the effective oiling of all the working parts. The main crank shaft and generator bearings are ring lubricated, while each cylinder is fed at four points from a mechanically operated lubricator. From the same lubricator, oil pipes are taken to the gudgeon pins and also to oil catchers attached to the crank webs, from which points the oil passes to the large end bearings of the connecting-rods. Mechanical fuel injection is used, and the amount of oil delivered to the cylinders is directly controlled by a sensitive centrifugal governor. The engine has been designed to work with heavy residual fuel oils, and we learn that water injection is not required under any load conditions. Engines of this type are built in various sizes ranging from 15 up to 200 brake horse-power.

In the fore-front of the stand a fine example of an Allen 250-kilowatt turbo-generator is shown. We reproduce a view of this set in Fig. 226. It will be noticed that the top covers of the turbine and the gear-box have been raised, permitting the examination of the blade wheels and the reduction gears and pinions.

The turbine is of the impulse type and runs at a speed of 6000 revolutions per minute, reduced to 650 at the generator by means of single gearing. There are two stages of steam expansion, the first through a wheel with two rows of blading and the second through a single-bladed wheel. All blades are machined from the solid, and are made of phosphor bronze of special quality. The turbine is designed to utilise steam at a pressure of 210 lb. per square inch, with a total temperature of 590 deg. Fah., and exhausting against a back pressure of about 20 lb. per square inch above atmospheric pressure. At the end of the turbine there is a centrifugal governor, which controls the throttle valve by means of an oil relay. An emergency governor is also fitted, which will automatically cut off the steam and stop the turbine, should the speed of the machine rise above a predetermined maximum. A pump of the geared valveless type, driven from the main shaft of the turbine, provides oil under pressure for lubricating the main bearings and the reduction gears, and also for operating the oil relay on the speed control governor. The reduction gearing has double helical wheels, and it will be noted that the pinion shaft is connected to the turbine by a flexible coupling of the claw type. The pinions are made of nickel steel, and are forged solid with the shaft, while the rims of the main gears are of mild steel, and are shrunk and pinned on to the cast iron wheel centres. In cutting the teeth a hobbing method is employed, with a creep motion fitted on the wheel table, which ensures great accuracy of tooth form and pitch.

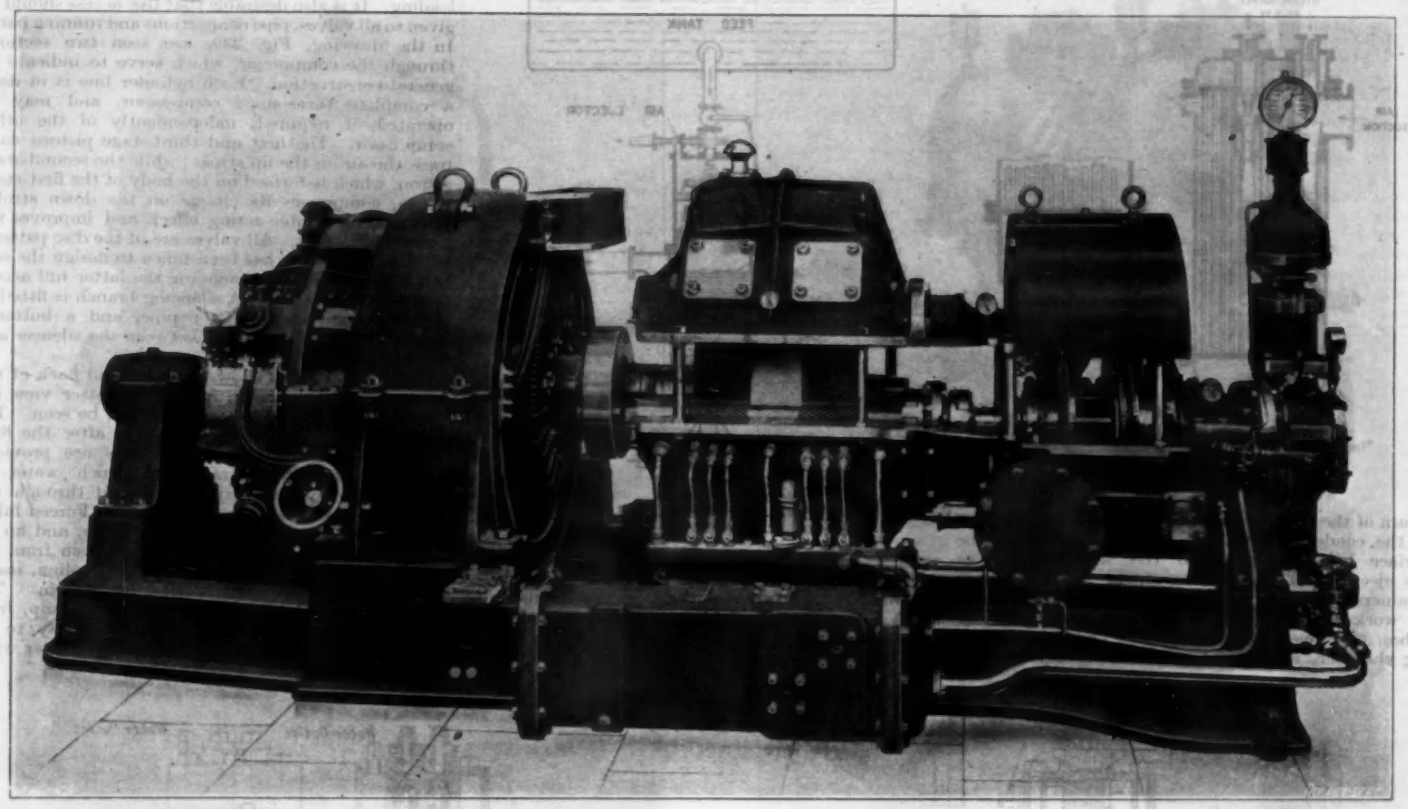


FIG. 226—250 K.W. TURBO-GENERATOR—W. H. ALLEN, SONS AND CO.

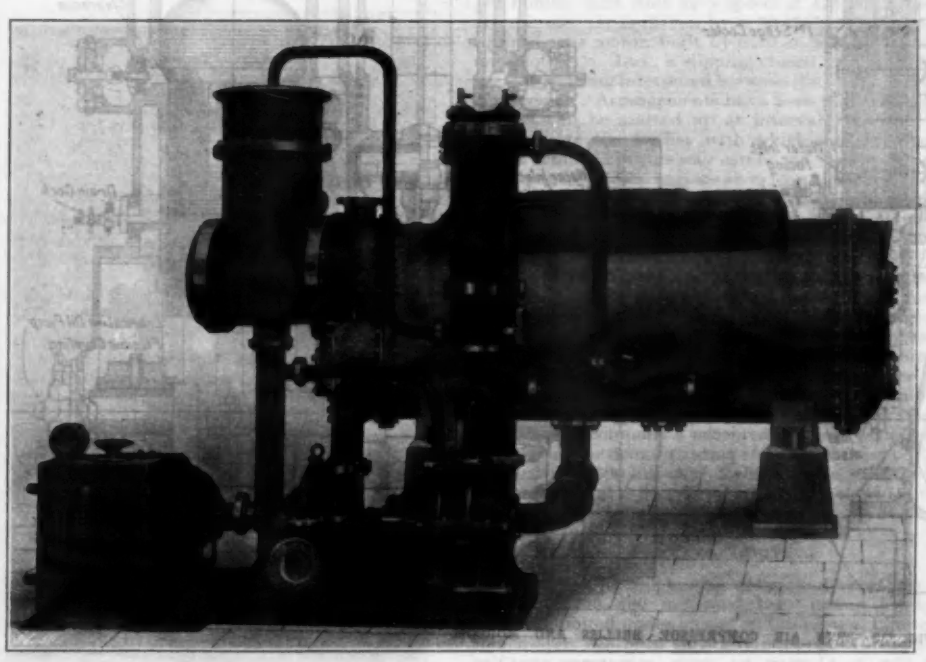


FIG. 227—CONDENSING PLANT—ALLEN

The dynamo shown is of the shunt type, with interpoles, and is constructed for 110-volt supply and for a normal output of 250 kilowatts, with an overload capacity of 312 kilowatts for a period of two hours. Turbo-alternators, with a direct drive, are also built by the firm.

A steam generating set of the familar Allen high-speed type is also exhibited. This set comprises a two-cylinder compound vertical engine of the enclosed type fitted with forced lubrication, which drives direct a 100-kilowatt, 220-volt, direct-current generator, running at a speed of 500 revolutions per minute. The engine is designed for use either with or without a condenser and for steam pressures varying from 105 lb. up to 200 lb. per square inch. The high-pressure cylinder is 10in. diameter and the low-pressure cylinder 16in. diameter, with a stroke of 7½in. At the normal speed, the engine is designed to develop 150 brake horse-power.

Conspicuous on the stand are exhibits of the firm's standard pumps for mine, irrigation, boiler feed and marine service. A notable exhibit is a boiler feed pump, driven by an impulse type turbine, similar in design to that which we have already described. This type of feed pump is built for both power station and marine work.

Marine circulating and sanitary pumps are represented by a motor-driven set designed for an output of 400 gallons of water per minute, when working against a head of 70ft. The motor runs at a speed of 1300 revolutions per minute, and at the duty above mentioned the efficiency of the pump is, we understand, 67½ per cent. For marine work, both the pump casing and the impeller are usually made of gun-metal, and the shaft is sheathed with gun-metal where it comes into direct contact with the water. A feature of the design of this class of pump is the use of an oblique split casing, which gives a vertical discharge branch and at the same time enables the pump rotor to be inspected or removed without breaking the pipe joint.

Condensing plant has been a speciality of the firm for many years, and an exhibit—illustrated by Fig. 227—has been arranged to show some of the later developments. The group comprises a set of electrically driven circulating and condensate pumps, combined with an Allen Compactum air pump and Allen De-aerator. At the Exhibition a surface condenser,

similar to that illustrated by Fig. 227, is shown in the form of a painted background. A two-stage centrifugal pump is used to extract the condensed water and to discharge it through the tubes of the heater, which is embodied in the casing of the Compactum air pump. This pump will be more clearly understood from the illustration reproduced in Fig. 228. It is of the two-stage steam ejector type, and the heat of the operating

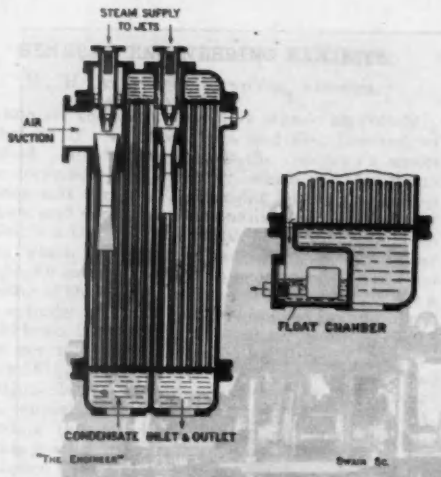


FIG. 228—COMPACTUM AIR PUMP

steam of the ejectors is used to raise the temperature of the condensate, which is circulated through the surface heaters built into the same casing as the ejectors. The operating steam passes through strainers into the ejector nozzles, and after doing its work on the air it is condensed on the heater tubes, and the condensate, falling into a collecting chamber, is returned to the condenser through valve, and falls through perforated trays on to the surface of a series of horizontally disposed tubes, which are kept at a high temperature by exhaust steam which circulates through them. The entering water is sprayed over the tubes under vacuum and when it

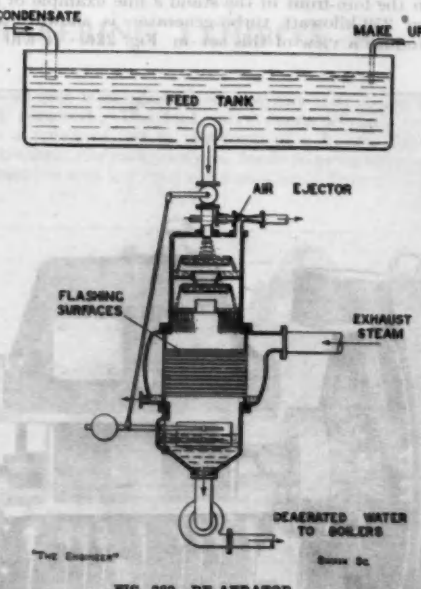


FIG. 229—DE-AERATOR

reaches the "flashing surfaces" of the hot tubes, its particles are broken up. The entrained air and gases are thus freed, and are removed from the chamber by a small steam ejector. A high-temperature feed water practically free from oxygen is thus given, which does not cause corrosion in the boiler and economiser

In the accompanying illustrations—Figs. 230, 231, and 232—we show a special twin air compressor which the firm has recently produced in order to meet the requirements of auxiliary plant for motor ships. On a motor ship it is usual to have one or more auxiliary air compressors in order to supply the compressed air for starting the engines and for fuel injection. Such machines should be strongly built, compact in design and capable of continuous service for long periods under any required condition of loading. It is also desirable that free access should be given to all valves, pipe connections and running parts. In the drawing, Fig. 230, are seen two sections through the compressor, which serve to indicate its general construction. Each cylinder line is in itself a complete three-stage compressor, and may be operated, if required, independently of the other compressor. The first and third-stage pistons compress the air on the up stroke, while the second-stage piston, which is formed on the body of the first-stage piston, compresses its charge on the down stroke. This gives a double-acting effect, and improves the balance of the set. All valves are of the disc pattern, and particular care has been taken to design the seat and cover, so that by removing the latter full access to the valve is given. A silencing branch is fitted to the first-stage suction inlet pipe, and a butterfly air regulator valve is placed between the silencer and the suction valve.

Figs. 231 and 232 show the front and back of the compressor respectively, and in the latter view the vertical tube type of intercoolers will be seen. The air is cooled after each stage and after the final compression, and all the intercoolers are provided with an efficient separator in which water or emulsified oil which may have passed through the compressor is collected and blown off. Forced lubrication is fitted to all the moving parts, and an oil pump of the geared type, which is driven from the main crank shaft through a flexible coupling, maintains pressure in the lubricating system. The crank chamber is provided with an oil sump, from which all lubricating oil is drawn away to an outside tank. After passing through a filter with-

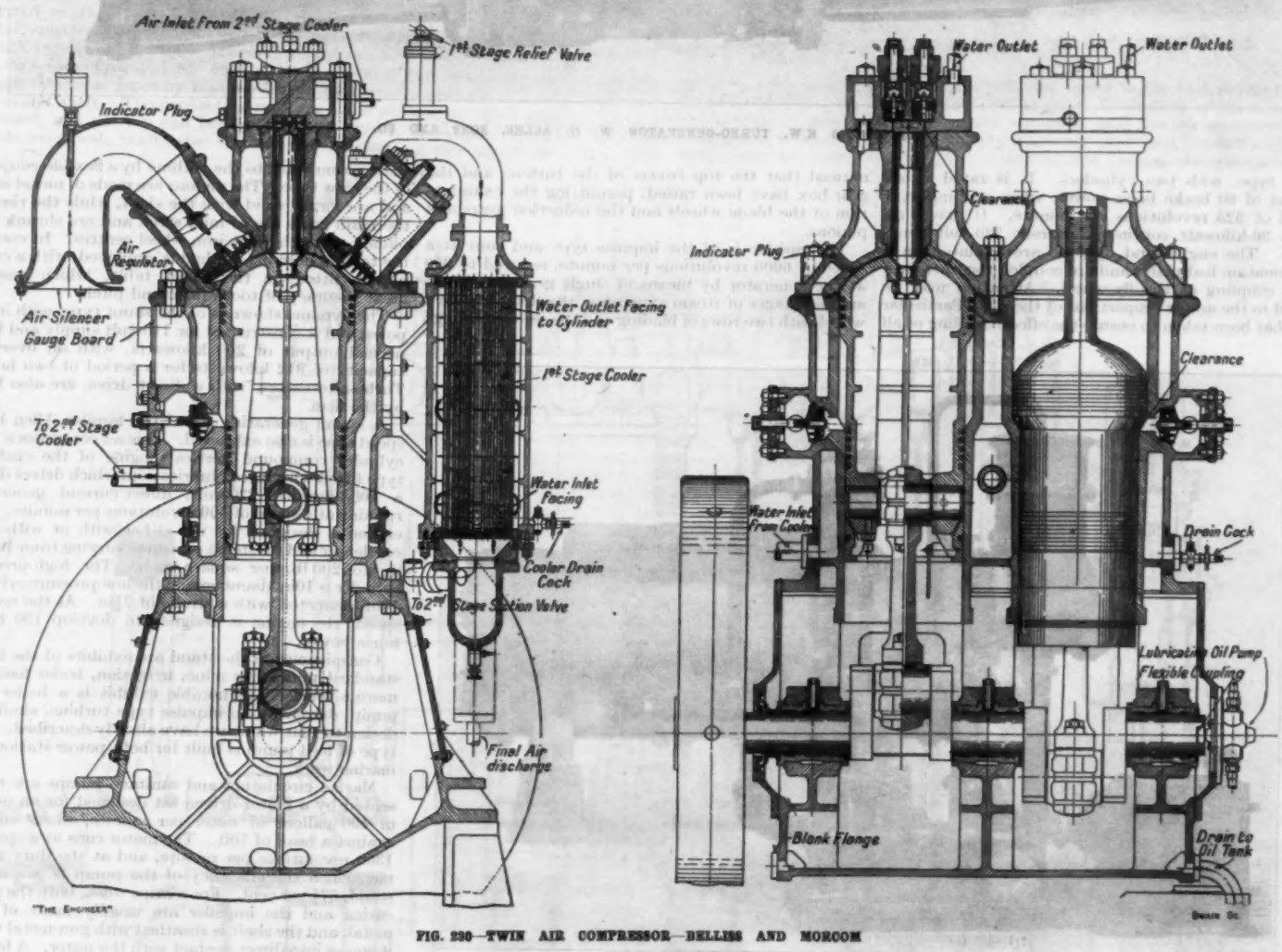


FIG. 230—TWIN AIR COMPRESSOR—BELLISS AND MORCOM

float-operated valves. The apparatus is self-contained and simple in its action. We are informed that a high efficiency is ensured, inasmuch as practically all the heat contained in the operating steam is absorbed by the feed water which is delivered to the boilers. Another interesting part of the apparatus is the De-aerator, through which the condensate passes after leaving the air pump. The diagram, Fig. 229, serves to illustrate its action, and also shows some details of construction. After leading the feed tank, the water passed downwards through a float-operated tubes. The De-aerators we have described may be used with advantage for bleeder heating, and they are suitable for power station work of all kinds. Both the Compactum air pump and the De-aerator are manufactured, we learn, under licence from the Contra-flo Condenser and Kinetic Air Pump Company, Ltd.

BELLISS AND MORCOM, LIMITED.

Among various examples of air and gas compressing plants shown at Wembley, a noteworthy exhibit is that of Belliss and Morcom, Limited, of Birmingham. in the tank the oil is returned to the pump circuit.

The compressor we illustrate is designed to deal with 400 cubic feet or 11.3 cubic metres of free air per minute, and to compress it to 1000 lb. per square inch or to 70 kilos. per square centimetre, when running at a normal speed of 375 revolutions per minute. Similar compressors are constructed in four sizes of 150, 200, 300 and 400 cubic feet capacity, and intermediate capacities may be met by adjusting the running speed of the nearest size. All are designed so that they may be

driven by an oil engine, steam engine or electric motor.

Another type of Belliss compressor is shown in Fig. 233. The high-pressure unit illustrated is a two-crank five-stage machine which is designed to deal with 353 cubic feet, or 10 cubic metres of free air per minute, and to deliver it at a pressure of 2350 lb. per square inch, or 165 kilos. per square centimetre, when running at a speed of 210 revolutions per minute. Like the compressor previously described, ample sized intercoolers are provided, both between the stages and after the final stage. All working parts are enclosed, and are fitted with forced lubrication. The machine was specially designed for commercial use, and to operate continuously at full load and pressure over long periods of service. This type of machine may be used for charging compressed air locomotives or for compressing gases for industrial uses.

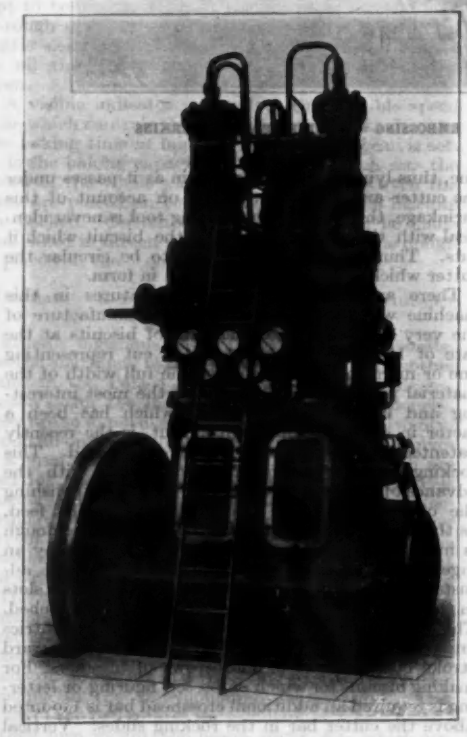


FIG. 233—FIVE-STAGE COMPRESSOR—BELLISS

Other exhibits on the stand include a high-speed two-stage compressor of 2000 cubic feet free air capacity, designed for a working pressure of 100 lb. per square inch, when running at 231 revolutions per minute. Similar machines are extensively used in shipbuilding work. A smaller single-stage single-acting compressor, designed for 100 lb. working pressure, is also shown. It deals with 200 cubic feet of free air per minute, and runs at a speed of 428 revolutions per minute. It is driven by a 50 brake horse-power squirrel-cage motor, built by the Lancashire Dynamo and Motor Co., Ltd., a slipping clutch of the centrifugal type being interposed between the motor and the compressor. Arrangements have been made whereby the set can be started up at intervals, in order to demonstrate the facility with which a squirrel-cage motor arranged in this way can be put into operation.

Among the steam engines shown on the stand is the No. 1 quick-revolution engine, which was the first of this type made by the firm—in 1890. It develops 20 brake horse-power, and was in constant service, we learn, until 1919. The original cylinder and crank shaft are exhibited, and examination shows that remarkably little wear took place during the twenty-nine years of service. High-speed Belliss type engines for which, we understand, there is still a steady sale, are represented by two engines of 200 and 120 brake horse-power. A three-cylinder paraffin engine of 20 brake horse-power is also shown. Minor exhibits include several compressor valve details, and specimens of the company's patented air hose couplings, with means for demonstrating the air tightness of this fitting. A 1500-kilowatt Belliss steam turbine is also shown, and a jet type of condenser, to which exhibits we hope to refer in a later article.

FIGS. 231 AND 232—FRONT AND BACK VIEW OF TWIN AIR COMPRESSOR—BELLISS AND MORCOM

GALLOWAYS, LIMITED.

On account of its pleasing design and sweetness of operation, the 500 indicated horse-power Uniflow engine exhibited under steam by Galloways, Limited, Manchester, has been generally admired. From the half-tone engravings given on page 14 it will be noted that this engine conforms in its general design to this firm's standard productions, a prominent feature being the oil-operated valve gear, which has been already described in THE ENGINEER of August 26th, 1921. Care is taken in the design and construction of this engine to ensure that all losses of heat by radiation and conduction are minimised, particularly at the connection of the cylinder to the bed-plate. The valves are of cast iron, of the double-beat drop type, small in diameter and depth, but of ample area. This construction obviates distortion and gives steam-tightness under high superheat. The oil valve gear is simple in operation. In the sectional view—Fig. 234—it will be seen that oil under pressure is applied below the plunger A connected to the valve spindle B, and lifts the valve, which seats itself again by the action of a spring and dashpot C when the fluid pressure is released. An excentric on the lay shaft operates the ram D of an oil pump, arranged in the valve bonnet. This pump ram is hollow, and has a ring of slots or ports E, which at certain parts of the travel may be covered by a sleeve F surrounding it, the axial position of this sleeve being controlled by the governor. On the up stroke of the pump, oil is forced by the ram into the pressure chamber below the plunger, thus raising the latter and the steam valve. At a point determined

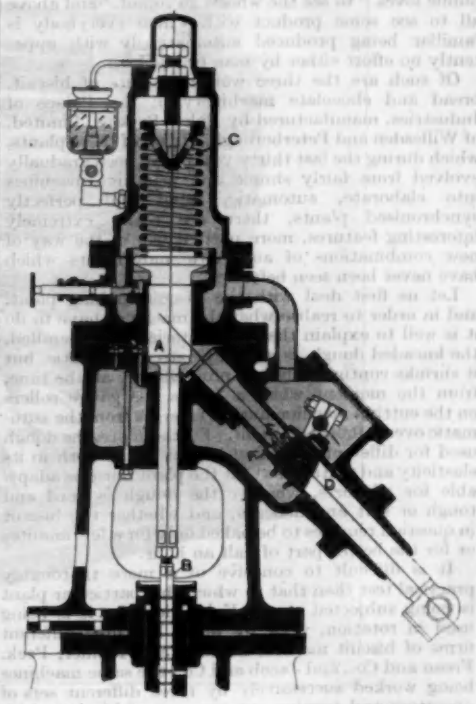


FIG. 234—OIL-OPERATED VALVE GEAR—GALLOWAYS

by the position of the governor, the ports in the hollow pump ram overrun the sleeve, and the oil escapes through the ports back into the oil reservoir, whilst oil returns to the pump chamber through the ball valves seen near the letter A. The level of oil is indicated by a tint in the drawing. The steam valve then closes under the combined action of the spring and the dashpot piston, the seating taking place rapidly and quietly. With this oil valve gear a very late cut-off can be obtained up to the end of the stroke, if desired, giving the engine a high overload capacity, which is of great advantage when operating rolling mills or where the steam pressure is liable to fall temporarily to a considerable extent. The engine shown at Wembley differs from previous engines as regards the compression release gear. It has auxiliary exhaust valves on the side of the cylinder, similar to those previously fitted, but the valves are now operated by oil pressure. Whether they are to be opened at all, or, if so, to what extent and for what length of time, is determined by means of a piston contained in a small cylinder and operated by the vacuum in the condenser or from the exhaust pipes. According to the degree of vacuum, this piston affects the adjustment of the controlling sleeve of an oil valve gear similar to that on the steam admission valves. At full vacuum, the auxiliary valves do not open at all; at partial vacuum, they open slightly; and at no vacuum, they have maximum opening, thus effectively and automatically controlling the compression pressure under all circumstances.

The following particulars relate to this engine, as it would normally be arranged for working condensing:—

Cylinder diameter	25in.
Stroke	2ft. 6in.
Speed	150 revs. per min.
Steam pressure at stop valve	155 lb. per sq. inch
I.H.P.	500
Piston-rod diameter	4½in.
Crosshead pin	6½in. by 8in.
Crank pin	10½in. by 15½in.
Main bearings	10½in. by 15½in.
Outer bearing	8½in. by 16in.
Fly-wheel, grooved for rope drive	11ft. diameter 10 tons weight

As regards steam consumption, with steam at the stop valve at 155 lb. per square inch and 150 deg. Fah. superheat, and with condensing water at 70 deg. Fah., the steam consumptions expected by the makers under ordinary working conditions are:—

At 375 I.H.P.	11.25 lb. per I.H.P. hour
430 I.H.P.	11.3 lb. „ „
500 I.H.P.	11.4 lb. „ „

The makers state that these figures are obtained in regular work, and do not represent the absolute minima which can be attained with a specially attuned engine.

FOOD PRODUCTION PLANT.

Automatic Biscuit Making Machinery.

Unquestionably among the mechanical exhibits at any exhibition those that draw the crowd are the complete model factories in full operation. The great public loves "to see the wheels go round," and above all to see some product with which everybody is familiar being produced automatically with apparently no effort either by man or machine.

Of such are the three working plants of biscuit, bread and chocolate machinery in the Palace of Industries, manufactured by Baker Perkins, Limited, of Willesden and Peterborough. In all of these plants, which during the last thirty years have been gradually evolved from fairly simple and primitive machines into elaborate, automatic, rapid and perfectly synchronised plants, there are many extremely interesting features, more particularly in the way of new combinations of automatic movements which have never been seen before.

Let us first deal with the biscuit making plant, and in order to realise what the machines have to do it is well to explain that the material to be handled, the kneaded dough, is not only extremely elastic, but it shrinks continuously and progressively all the time, from the moment when it leaves the gauge rollers on the cutting machine until it emerges from the automatic oven a finished biscuit. Furthermore, the dough used for different classes of biscuit varies both in its elasticity and texture, so that the plant must be adaptable for all sorts, whether the dough is hard and tough or soft and delicate, and whether the biscuit in question requires to be baked only for a few minutes or for the better part of half an hour.

It is difficult to conceive of a more thoroughly practical test than that to which this particular plant is being subjected at the Exhibition, for it is being used in rotation, week by week, by three different firms of biscuit makers, Huntley and Palmer, Peek, Frean and Co., and Jacob and Co., the same machines being worked successively by three different sets of operators and turning out any sort of biscuit which the firm in question may choose for the time being.

Each of these firms has its own practice with regard to the ingredients of which doughs are composed. These are mixed in a separate room in a machine which is utilised by each in turn. The receiver of the mixing machine is a wheeled truck, into which are introduced two spindles, each fitted with a series of rotary beater arms which effect the mixing. The beaters are withdrawn when the process is complete by means of vertical screw gear, and the receiver, with the finished dough, is wheeled away and a new one takes its place.

It is at this point that the public is permitted to see the operations of the machines, of which there are three, in strict alignment with each other, viz., a "reversing dough brake," an "automatic continuous movement cutting and embossing machine," and an "automatic oven." The "dough brake" is in reality what, if the material dealt with were steel ingots instead of dough, would be called a rolling mill, see Fig. I. in our Supplement. The dough from the mixing machine is placed upon the loose endless band or "web," which passes over the bottom roller, but does not travel until the dough is introduced between the two rollers, when it is propelled forward by the friction caused by the pressure of the rollers on the dough. The function of the web, which may be made either of canvas or flannel, is to relieve the softer doughs of all tensile stress as they pass between the rollers. When tough material is being worked the web is not used and the dough is merely placed upon a stationary table.

The dough is passed backwards and forwards through the rollers until it is reduced to the required thickness for the next operation, the thickness being regulated after each passage, by the hand wheel shown, and indicated on the dial above the machine. The reversing of the rollers is done by a reversing electrical motor which drives the machine and is direct-coupled to it. The dough is presented to the rollers by hand, under a wire safety guard which is lowered until there is only just sufficient room for the operation, and is so fitted that, should the operator's hand pass too close to the rollers, the back of his hand or wrist must touch the guard. This contact, by slightly lifting the guard, releases a spring trigger which throws out a clutch mechanism connected with the driving pinion, and thus stops the machine instantaneously. The object of this machine, apart from reducing the dough to a suitable thickness for the next operation, is to impart to it a flakey and uniform texture and to determine its consistency.

On leaving the "dough brake" the material has the appearance of a heavy and thick blanket, and in this form it is presented to the cutting and embossing machine, the operations of which are intensely ingenious and interesting. This machine is shown in Figs. II. and III. in our Supplement and in Fig. 235 herewith, Fig. III. being a general view, Fig. 235 giving a better view of the front end of the machine showing the gauge rollers, and Fig. II. showing the tailing out of the cut biscuits on the final conveyor, which, in the picture, is in the act of depositing the biscuits on one of the "pans" or trays on which they are to pass through the oven. In the foreground is a completely filled pan.

In this machine the dough passes first through two pairs of gauge rollers, the last of which reduces it to the final thickness for cutting. Each pair of rollers is served by its own independent travelling web conveyor, and a third one carries the elongated dough under a revolving brush, which is used to polish the surface of the more highly-finished biscuits. A fourth conveyor carries the dough under the cutting and embossing tools and takes the cut and embossed biscuits with their surrounding "scrap" on a downward gradient to a point where a fifth conveyor with an upward incline takes the scrap and delivers it into a bin or hopper which, when full, is removed so that the scrap may be re-passed through the whole process. Meanwhile the biscuits travel below a fifth conveyor and are transferred automatically from the fourth to a sixth conveyor, the function of which is to deposit them eventually on pans, which are inserted as required on a travelling chain below the visible portion of the machine but come into sight again before they receive the biscuits.

The automatic depositing of the biscuits is one of the most interesting movements in this elaborate machine. It is done in this way. The sixth conveyor, on which the rows of biscuits are carried forward, passes at its ultimate end round a knife edge support, while still travelling. Simultaneously with the advance of the pan below it, this knife edge, with the conveyor, retires with a reciprocating movement, thus depositing in turn each successive row of biscuits in its proper position on the pan.

The reason for this complex series of web conveyors is the progressive shrinkage of the material which, as already stated, goes on continuously from the time when the dough leaves the gauge rollers. To compensate for it the speeds of the various webs are different, and in each one the speed is individually variable. Thus at certain points, as, for instance, in passing from one web travelling at a certain speed to another which runs rather slower, the dough will be purposely "bunched" by the over-running of the preceding web, but as it is carried forward it gradually, owing to shrinkage, resumes the straight line, thus lying perfectly flat again as it passes under the cutter and embosser. Also, on account of this shrinkage, the shape of the cutting tool is never identical with the eventual shape of the biscuit which it cuts. Thus if the final shape is to be circular the cutter which makes it must be oval in form.

There are many entirely new features in this machine which is designed for the manufacture of the very finest and most delicate of biscuits at the rate of 150 cuts per minute, each cut representing one or more rows of biscuits to the full width of the material passed under it. One of the most interesting and important new points which has been a factor in attaining this high output, is the recently patented rocking movement of the cutter head. This rocking movement synchronises exactly with the advance of the web conveyor below it, thus abolishing the objectionable and retarding intermittent feed, as the biscuits are cut and embossed while the dough is in motion. The rocking motion is effected by an ingenious link mechanism and cams which are adjusted as required. A steel bar is carried in slots in the rocking head to which the cutters are attached. This bar is given a reciprocating motion by eccentrics on each side of the machine, and at each downward stroke cuts out one or more rows of biscuits. For making biscuits for which embossed figuring or lettering is required an additional crosshead bar is mounted above the cutter bar in the rocking slides. Vertical connecting-rods couple this crosshead to cam-controlled levers near the base of the machine, and the whole mechanism is kept in contact with the cams by powerful spiral springs surrounding the rods. The cams are so formed as to operate the embosser before the cut. The cutting and embossing, therefore, are two distinct operations, though done during the same stroke of the machine.

FIG. 235—CONTINUOUS DOUGH-CUTTING AND EMBOSSING MACHINE—BAKER PERKINS

To revert to the operation of depositing the biscuits on the pans, already referred to, it is essential that it should be absolutely synchronised with the cutting of the biscuits, and regulation is effected by a special epicyclic mechanism adjusted by a hand wheel. The number of strokes per minute is regulated at will by a variable speed gear in the main frame of the machine, and the machine can be instantaneously stopped at any time by any one of a series of push buttons placed conveniently at various points on both sides.

From the cutting machine the pans are passed to the automatic oven. If the cutting machine is to be worked at full capacity there should be two 50ft. ovens each capable of taking three rows of pans. At the Exhibition, on account of the exigencies of space, a single two-row oven 40ft. long is used, as shown in Fig. V. in the Supplement. A chain conveyor, the speed of which is varied to suit the time required for baking the type of biscuits being dealt with, passes from one end of the oven to the other. On this the pans are laid. The heating is done by a series of rows of Keith-Blackman gas burners, above and below the pans at right angles to the length of the oven, so arranged as to distribute a uniform heat throughout the oven. As individual burners are apt to be extinguished in various parts of the oven, through draught or other causes, there is an automatic electric spark relighting device which operates at all times throughout the entire length of the oven.

A visible indicator is fitted to the variable speed gear which controls the advance of the pans. It gives the baking time in minutes to which the gear is set. It is the baking capacity of the oven which sets the speed of the whole plant. On leaving the oven the pans are placed on cooling racks before the biscuits are packed. Certain forms of biscuits can be made and baked in fifteen minutes from the time the dough is placed in the "dough brake."

AUTOMATIC AND SEMI-AUTOMATIC CONFECTIONERY MAKING PLANT.

Equally ingenious, though somewhat less elaborate, are the machines by the same firm used on another stand in the Palace of Industries—that of Messrs. Carson's—for the mass production of confectionery. They are so extensive and varied, there being twenty-two in all on exhibition, that we shall confine ourselves to a brief outline of the special machines which are used for the making of "chocolate creams." This process is in reality a double one, first the manufacturing of the chocolate and then the enveloping of any sort of palatable substance with a coating of the chocolate. Both processes are carried on within sight and within a few feet of the visitor.

The five machines used for the purpose are the "mélangeur," the "refiner," the "conche," the "kettle," and the "enrober." The mélangeur, or mixer—see Fig. 236—consisting of a pair of heavy drum grindstones rotating in a revolving pan, works on the principle of the time-honoured mortar mill. The action of the pan rotates the grindstones, which crush, of their own weight, the beans, sugar, &c., which are destined to form the substance of which chocolates are made. As they rotate, the stones are cleaned by scrapers, and the stones are lowered gradually as the mass becomes more viscous. It is here, however, that the features of the mortar mill cease. The two stones are not fitted to one horizontal shaft, but are on independent shafts, and one of them may be lifted and revolved independently of the movement imparted to it by the pan. This adjustment is utilised for emptying the pan. To effect this, the scraper is removed, and the stone is lifted until its lower edge is near the surface of the mixed material. It is then, by independent gear, revolved somewhat faster than the speed of the pan, thereby lifting the mixture progressively to the top of the stone and discharging it down a shoot, much as water is discharged from an overshot water wheel, though the consistency of the stuff at this stage is that of thick clay.

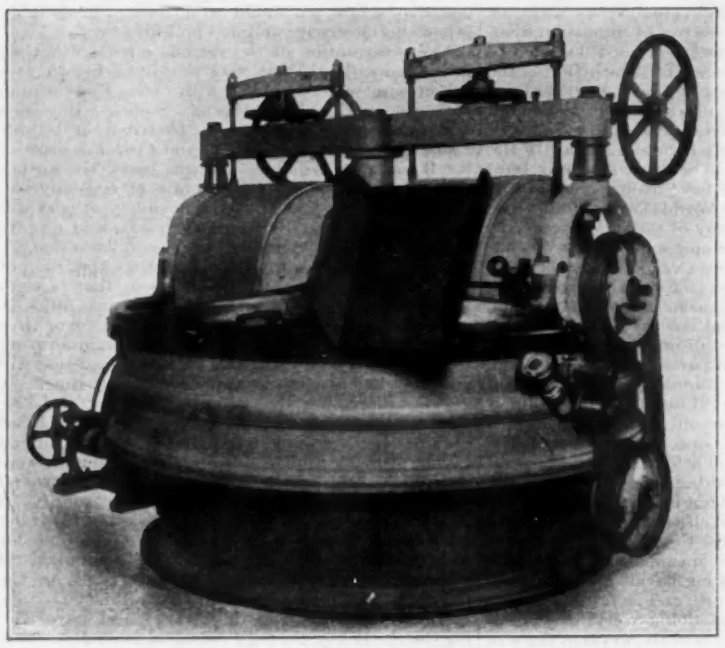


FIG. 236—CHOCOLATE MÉLANGEUR—BAKER PERKINS

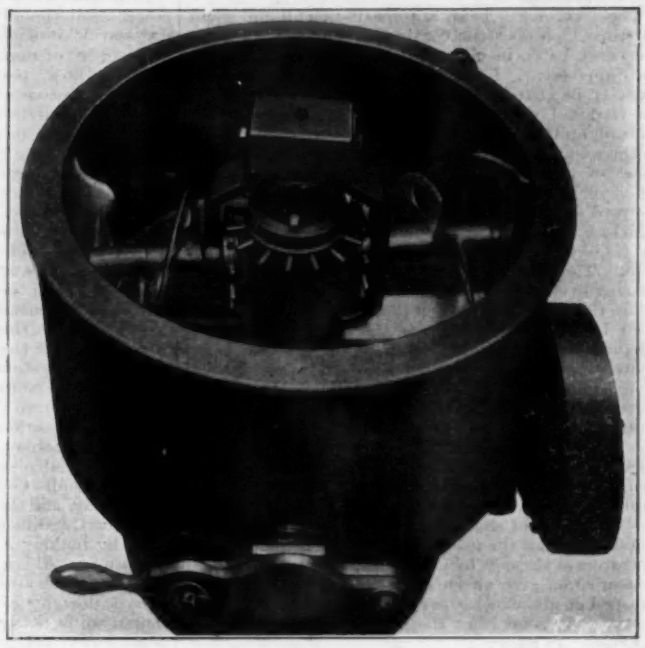


FIG. 237—CHOCOLATE KETTLE—BAKER PERKINS

From the mélangeur the material is passed to the refiner, which is, in fact, a fine-grinding machine, as shown by Fig. 238. It consists of five chilled steel horizontal grinding rollers, four of which are placed vertically one above the other, the fifth, which is the bottom one, being staggered so that the material from the mélangeur may be conveniently fed between it and the next roller by means of a hopper. Each succeeding roller, counting upwards, is revolved rather faster than the one below it, thus increasing the grinding effect, and at the same time raising from roller to roller and between each a thin film of the ground material, until it reaches the top roller, from which it is removed by a scraper. All the rollers are water cooled, and the top and the third rollers, which have to support the greatest stress, are mounted in self-aligning roller bearings. The object of this machine is to produce between the rollers as fine a film of chocolate as is humanly possible, and the adjustments of the machine are therefore a matter of extreme accuracy.

From the refiner the chocolate, which is now practically dry, passes to the "conche"—Fig. VI. in the Supplement. This machine, which takes a charge of 2½ tons of chocolate in its four tanks, is again a species of mixer, and it is in it that flavour is developed in the mixture. A double-throw crank actuates four bent connecting-rods, each operating in one of the steam-jacketed tanks. To the end of each rod is fitted a pair of free rollers, which revolve in either direction as they are reciprocated along the bottom of the tank. The heat of the tanks brings back the mixture to liquid form, and completes the mixing, the liquid mass being removed from the tanks through slide doors at the end.

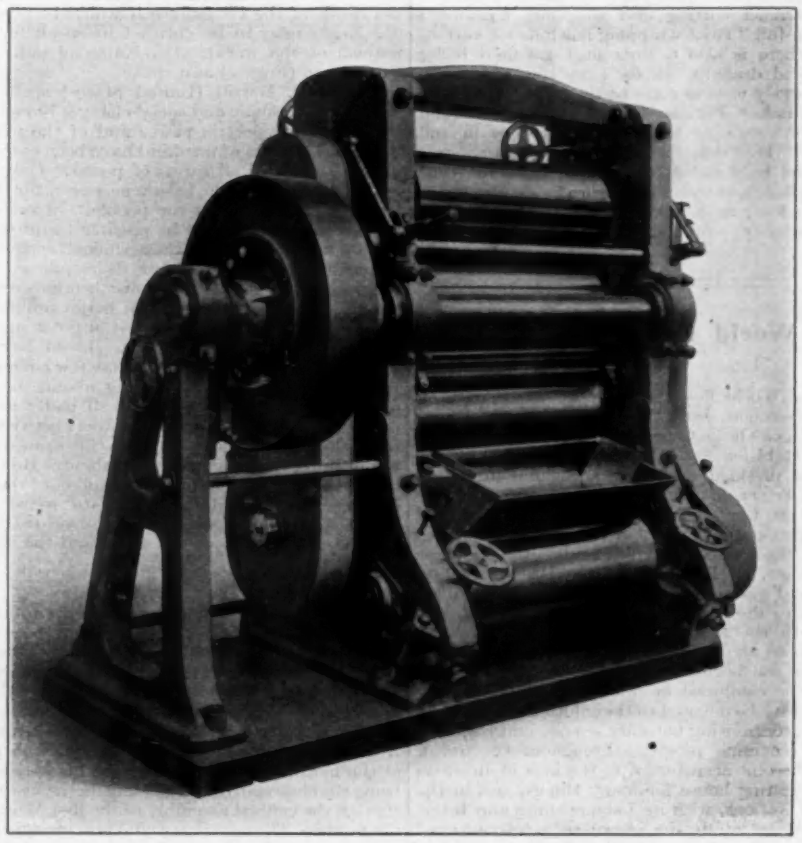


FIG. 238—CHOCOLATE REFINER—BAKER PERKINS

The object of the "kettle," to which the chocolate is then submitted, is not, as its name implies, further to heat it, but to reduce its temperature, and so to

bring it to a uniform and somewhat glutinous texture or temper, which adapts it for use in coating the material which it is destined to envelop. This machine is shown by Fig. 237, and its action is clearly demonstrated in the picture. It is fitted with patented aluminium helical mixing blades, which, by an arrangement of gearing, are made to revolve round the pan, in addition to rotating on their own axis. By this means, a perfectly mixed and evenly tempered mass of chocolate is obtained.

The "enrober" is an automatic machine of great length, which does the coating of the foreign matter "centres" with its chocolate envelope, see Fig. IV. in the Supplement. In it the "praline," or other suitable paste to be coated, is placed on the praline cutter at the feed end of the machine, in the foreground of the picture, and after being reduced by the rolling action to the required thickness, the centres are cut from the sheet of paste and automatically deposited on the conveyor web of the enrober. They are then carried forward and pass over the "bottoming" attachment, which, by means of a wire band and arrangement of rolls, gives the first coating of chocolate to the underside. They are then transferred to another web passing over a cooled table so as to set the chocolate. From this web they pass on to a specially constructed wire band, which traverses the centre or coating portion of the machine. Whilst on this band the centres pass through a curtain of chocolate flowing from a patented "finistherm" attachment, the purpose of this attachment being to bring the chocolate to a suitable condition so as to produce good coating, at the same time eliminating the air bubbles from the chocolate mass. From the end of the previously mentioned wire band the chocolates pass over the anti-tailing device, which, as its name infers, prevents the formation of small tails, and are delivered on to the final web of the machine. Whilst on this web the operators at the side, by means of specially constructed instruments, give various marks and designs to the finished goods, which then pass on through the automatic cooler, and when they emerge from the far end are ready for packing.

The other machines on this stand are a Brotherhood 5-ton refrigerating and air-conditioning plant; a complete "wafer" (light biscuit, subsequently coated on the enrober) making machine; an "ovamixa," which prepares the material for the "wafer" machine; a universal mixing and kneading machine; a Baker chocolate kneading machine; an automatic cooker for hard-boiled sweets; a special mixing pan for toffee ingredients; pouring plates, which receive the stuff from the cooker and pass it on to the "batch roller," which reduces it to string form, and feeds it direct into an automatic cutting and wrapping machine, which puts on the paper wrapper; a caramel brake; caramel cutting and wrapping machines; and a "fan-tail" twist wrapping machine for various sweets. There is also a Bonecourt gas-fired boiler with induced draught fan for supplying the steam which is largely used in some of these processes.

Messrs. Baker Perkins have on another stand a complete automatic bread-making factory in full operation. By this process the materials are not touched by hand at any stage, from the time when the flour and water are poured into the mixer until each loaf, as it leaves the cooling conveyor, is automatically wrapped in air-proof paper and sealed.

The World Power Conference.

No. I.

THE first World Power Conference was opened on Monday afternoon, June 30th, by H.R.H. the Prince of Wales in the large Conference room of the British Empire Exhibition. Lord Derby, President of the Conference, presided at the ceremony, and in calling upon the Prince of Wales to speak, said that the holding of the Conference was an ambitious idea, but it was hoped and believed that it would be a success.

H.R.H. the Prince of Wales said:—It is a great pleasure that, as President of the British Empire Exhibition, I welcome the delegates who are assembled in session to discuss the many vital problems connected with the first World Power Conference. I feel this to be an occasion of great importance, for it may prove the beginning of a series of conferences whereby the combined knowledge and judgment of the world may be devoted to the solution of the many difficulties confronting not only science and research, but also economic progress throughout the world. We have become accustomed to the idea of an international clearing house for many things, and in the League of Nations, with its Labour Office and International Court of Justice, have seen international co-operation of work in political and labour questions and in law; but the deeper questions connected with industrial progress and equipment, with natural resources, with the conservation of energy and of fuel, and with standardisation in design and manufacture, have hitherto, I believe, been examined by each country in isolation, with results that are apparent to everyone. In this effort to create for industry, and especially for power, what the League of Nations intends for politics, lies, I think, the true significance of the World Power Conference, and in the belief that something more fundamental than merely technical discussions will result, I extend a cordial welcome to the distinguished representatives from other countries gathered here this afternoon. You are all familiar, I think, with the main objects of this World Power Conference, and have each, in your own degree, contributed to our knowledge of certain aspects, so that it is unnecessary for me to discuss the matter in detail; but there is one consideration which has appealed to me. You represent the views of the main countries of the world on certain questions attached to power, and though your individual views may not necessarily coincide, the mere fact of discussion in an atmosphere of mutual appreciation must do much to tighten those personal contacts which form the inspiring motive of progress in every great activity connected with the modern industrial state. We should find inspiration in the vision of over thirty countries here contributing each in its highest capacity to the discussion of one subject of more than merely temporary importance. You have before you in the reports submitted to the World Power Conference the raw material for a survey of the power resources of the world, and you can now explore many countries which have hitherto been veiled in mystery and assess at their true value the possibilities of an immense industrial development in many of them. You may from this material erect a structure which will go beyond the confines of one country or group of countries and include all parts of the world where man can hope to prosper. International co-operation may emerge from the realm of ideal into the realm of practical utilisation as the result of your deliberations here at Wembley, and I sincerely trust that the greatest possible success will attend them.

Sir Joseph Cook, speaking on behalf of the Dominions, said that he did not believe that we should get over the difficulties which the world is suffering from by making an attempt to get back to pre-war conditions. He could not imagine anyone getting over their difficulties by going backwards. It could only be done by going forward, and he firmly believed that if we went right ahead, doing everything in our power to explore the resources of the world in the way of more efficient utilisation of power for all purposes, we should be led again into the paths of progress and plenty for all concerned.

Dr. G. Semenza (Italy) speaking for the European countries, drew attention to the vast natural resources of Europe not yet developed to the fullest possibilities, and emphasised the point that the improvement in efficiency in power utilisation means so much in the saving of time and human effort and in the increase of production. This was the first time, perhaps, at any official meeting that one man—and he was glad it happened to be an Italian—had been able to speak for all the countries of Europe, and he hoped that as the result of the Conference it would be possible for one single man to be entitled to speak for all the nations of the world. Dr. Kamo (Japan) and M. Guilleaume (France) also spoke.

Mr. O. C. Merrill (United States) spoke of the enormous economic and social changes brought about by the use of electric power and of the manner in which the labours of mankind have been eased by the increasing use of all forms of power. Only in that way could there be the leisure necessary for the intellectual development of the people. In such a Conference as that it would be possible to discuss freely and on an equal footing the technical, economic, and financial problems of power development. Whilst there might be special problems owing to differences in national law and policy, their major problems were common to all, and it was a fact of great significance that some thirty-five countries should have representatives assembled there, because few circumstances were better calculated to bring about the mutual understanding which the world so badly needed at the present time. It was the contacts between people more than the contacts between Governments which would bring that understanding about. He therefore hoped that as the result of the Conference the nations of the world would learn how to move forward together with a common purpose towards a common goal, viz., the peace of the world and the welfare of mankind.

On Tuesday two groups of papers were taken, one group in the morning and the second in the afternoon. The former, composed of twenty contributions of varying length, dealt with the Power Resources of the British Empire and the United States, whilst the latter, which included no less than thirty-five papers, concerned itself with European, Asiatic, and South American Resources. Sir John Snell, who presided at the morning meeting, expressed his satisfaction at being the chairman of the meeting on the historic occasion of the general assembly of the first World Power Conference. The meetings would provide opportunities for the interchange of ideas between delegates of many nations, as to the best methods under widely varying conditions of utilising the natural power resources of the world. It was the duty of this generation to deal with those resources, not with an immediate commercial object, but as trustees for future generations. There was a great work to be done. To take only one example, we should not be content in the field of electric supply to consume nearly 3 lb. of coal per kilowatt-hour generated, when it was realised that by using improved methods the fuel consumption could be reduced to about half that figure. Great Britain had only within a recent period been educated in the economic advantages of a comprehensive and co-operative policy in the field of electric supply, and there were still obstacles in the way of the inauguration of a more economical system of power generation. For that reason, and for many others, he welcomed the participation in that Conference of the world's experts in power production. He believed that the revelation of what was being done in other countries would act as a stimulus to progress in Great Britain, and that a new era would be opened in methods of generating electricity and its applications.

The presentation of the various reports was then proceeded with. They may be divided into two sub-groups, one occupied with the Empire and the other with the United States. But one exception must be noted—a contribution by Sir Richard Redmayne, in which the *Coal Resources of the World* were handled. In this paper the author observes that, at the present rate of consumption, it is improbable that the world's supply of coal will last for more than 1500 to 2000 years, and repeats what he said last year at the Society of Arts, that we have more occasion to worry about the exhaustion of lead, zinc, tin, and copper than about that of coal. But the duration of coal supplies is, of course, different in different countries. America, with over five million-million tons, may look for an endurance up to 2000 years, whilst in Great Britain exhaustion will probably be complete in a quarter of that time.

After discussing the various grades of coal, Sir Richard considers our present prodigality of fuel and declares that "it would be possible to effect an annual saving of many million tons of coal per annum were a wide system of electrical transmission entered upon." He then briefly reviews other sources of power and concludes with an expression of his belief "that coal holds the field, and must continue for many hundreds of years to hold the field, as the general source of energy, heat, and artificial light in the industrial and domestic life of the world."

Almost equally wide in its scope a paper by Sir George Beilby *On Oil Production in its Relation to the Resources and Needs of the British Empire*, may next be considered. The only serious rival to oil as a source of heat and power is coal, the consumption of which is ten to twelve times as great; but in certain directions oil is making a remarkably rapid advance. For example, no more remotely than 1914, 89 per cent. of the mercantile marine of the world burnt coal, whilst now that figure is down to 69 per cent. But with the increase of oil consumption anxiety as to the endurance of resources increases, yet whilst it is far more difficult to estimate oil resources than coal resources and the alarming estimates of the approaching depletion of supplies may be wrong, other means of providing oil must be carefully considered. Fortunately the Empire is rich in shales from which oil may be distilled, but "from the outset it must be recognised that the winning and retorting of shale is from its nature an operation which can never be carried out at a cost which will compare with the relatively simple operation of boring and pumping for oil." After careful consideration Sir George Beilby believes that in Great Britain "the chief hope for the production of fuel oils on any adequate scale lies in the distillation of a considerable proportion of the coal which is at present consumed in the raw state." This problem, he says, was taken up by H.M. Fuel Research Station, whose Directors recognised that the principal problem was the replacement of the 35 million tons of raw coal burnt annually by domestic consumers by coke produced at 500 deg. to 600 deg. Cent. The production of a suitable coke was one of the most difficult features of the problem, but in 1919 success was attained, though in face of material and mechanical difficulties which have not yet been completely overcome.

Professor Henry Louis provided a paper entitled *Resources of the British Empire in Metals Employed in Power Machinery*. In it he reaches the comforting conclusion that "we have ample supplies available, more, indeed, than suffice for the needs of the Empire, except in the solitary case of copper, and even as to this there is good evidence that our supplies in case of urgency should meet our industrial requirements, although economically we are unable to compete with the enormous deposits of low-grade copper ore which contribute so greatly to the output of the United States. As far, therefore, as supplies of raw material are concerned, the Empire can look forward to the future with every confidence. In the economic struggle for industrial supremacy in the world's markets which the future will undoubtedly witness, numerous other factors will have to be taken into account. As regards quality of workmanship we have shown in the past that we can hold our own with all competitors, but unless all engaged in industry determine to keep prices down to the lowest possible level and to introduce methods of rigid economy into all branches of machinery manufacture, wealth of raw material alone will not enable us to maintain the leading position which we have hitherto held."

We may now briefly allude to a couple of papers on water power in Great Britain, the first by Professor Gibson, dealing with the *Water Power Problem in Great Britain and Ireland*, and the second by Dr. Crowley and Mr. Bergstrom, with the *Water Power Resources of Scotland*. In the first of these papers the

author discusses the possibilities of the development of water power in this country, and reaches the conclusion that 20 per cent. of the power requirements of Great Britain and Ireland could be satisfied by water power. The paper is based very largely upon the reports of the Water Power Resources Committee appointed in 1918 by the Board of Trade. In presenting it Professor Gibson, referred to the renewed attention which was being given to the utilisation of the power of the tides. He reminded the Congress that a detailed investigation was to be made of the possibilities of the Severn scheme, which, if carried out, might become one of the most important water power installations in the world.

Amongst the contributions dealing with particular parts of the British Empire we note especially three long papers, one on *The Power Resources of the Commonwealth of Australia and the Mandated Territory of New Guinea*, one on *The Water Powers of Canada, their Nature, Extent and Administration*, by Mr. J. B. Challier, and the third on *The Fuel Resources of Canada*, by Mr. B. F. Haanel. The first of these papers, which was compiled by the Institution of Engineers of Australia, is divided into two parts, the first of which is devoted to a review of Australian resources in water power, in coal, and in liquid fuel, whilst the second describes the power supply systems of the several states. The reporters are satisfied that ample natural resources of power are available for the development of Australian pastoral and mineral industries; there are abundant deposits of black coal and brown coal, and there are good prospects of the discovery of natural oil in commercial quantities. Moreover, some ten million horse-power may be developed from water in Australia alone and another ten million in the mandated territories. Recognising that a systematic survey of power resources is necessary, the Commonwealth Government has appointed a Standing Committee on Power Resources, which has already entered upon its duties.

The first of the two Canadian papers provides a national review of water power development in the Dominion. It is estimated that 40 million horse-power is available from rivers and falls, and of that so far only 3 million has been harnessed. The paper is accompanied by many maps, diagrams and tables and contains a great number of useful facts and statistics. The author of the second Canadian paper shows that Canada has enormous fuel resources of all kinds, crude oil alone excepted, and that with the constant augmentation of the demand for power more and more must be derived from heat engines. He gives some particulars and illustrations of notable boiler installations in Canada and touches upon the use of powdered fuel. He does not think that a field exists at present for the carbonising and briquetting of lignite, but he thinks that a solution of the domestic fuel problem can be found in the employment of the by-products recovery coke oven on a large scale, so that coke may be used domestically. This paper, also, contains many drawings and charts.

The remaining papers in Section A, which refer to power in the British Empire, cover British Guiana, the Indian Empire, New Zealand, Southern Rhodesia, and South Africa.

The whole field of power resources in the United States of America is covered by a group of five papers, of which the first, by Messrs. O. C. Merrill, N. C. Grover, and M. R. Campbell, is a national review; whilst the remaining four are regional reviews, one by Mr. John W. Lieb, of the North-Eastern States; another by Mr. Samuel Insull, of the Central States; a third by Messrs. A. H. Markwart and H. A. Barre, of the Pacific Coast States; and the last by Mr. W. S. Lee, of the South-Eastern Power Zone.

Mr. Armfeld, discussing Professor Gibson's report, advocated the development of water power in small units. He quoted the result of an investigation of the power resources of the Wiltshire Avon from that point of view. The average gradient of that river was 9ft. per mile and 400 brake horse-power was available in units from 10 to 200 brake horse-power. For installations of from 15 to 100 horse-power, the present-day general costs were from £20 to £40 per horse-power, and costs of £50 per horse-power were not infrequent. For installations of 500 horse-power and over, the capital costs were from £50 to £100 per horse-power. Large-power installations required a considerable head, and the civil engineering part of the work was a large item in the total cost. Big power projects also involved the transfer of water from one watershed to another, and were apt to conflict with other water interests. The small-power unit was cheaper, obviated the installation of transmission lines, and the losses associated therewith and could serve the needs of many areas.

Mr. G. W. Smith (United States) insisted that in spite of the prediction by Sir Richard Redmayne as to the exhaustion of resources, coal would remain the world's chief fuel, and could not be replaced by either oil or water power. In spite of the developments in these newer methods of power production supply was not keeping pace with demand.

Mr. David Rushmore (United States) expressed the hope that the possibility of using the work of the Conference in the constructive sense would not be overlooked, and that the future *rôle* of the organisation represented at the Conference would receive careful consideration. The world must take common action in connection with power supply. It was necessary to deal with the problems of the time which arose in each country, but a larger view of the position must be taken, and the machinery brought into existence by which those who had the gift of vision could obtain the realisation of their ideals.

Mr. W. S. Murray said that it would be unwise to place too much stress on the initial cost of power schemes. The percentage of power costs in industry was not more than 4 to 5 per cent. of the total manufacturing costs, and it should be recognised that power and transportation were the most important adjuncts in modern life and the basis of supremacy in world trade. The cost of power supply was a consideration secondary to that of an adequate supply.

At the afternoon session on Tuesday when Dr. George Otis Smith, Director of the United States Geological Survey, presided, the subject was the Resources of European, Asiatic and South American countries.

It is obviously impossible within the space at our disposal even to mention the titles of the thirty-five papers which occupied the attention of the Congress in Hall 1 on Tuesday afternoon. It must suffice to say that, taken together, they cover the power resources of practically the whole globe, with the exception of those parts which constitute the British Empire and the United States of America. They should form, until the second International World Power Conference puts them out of date, a valuable source of reference, for many of them have been prepared by official or Government bodies, and the remainder by individuals whose reports may be implicitly trusted.

These reports, some of which were not available in print, showed that in Europe the four great water power countries are Norway, Switzerland, Sweden and Italy, while Germany, France and Britain are mainly fuel-consuming countries. Latterly, however, political changes have contributed towards destruction of this difference. Austria, once a coal-consuming country, has had, in common with Hungary, to turn its attention to water power, owing to her coal reserves now being in possession of Czecho-Slovakia. Electrification of transport based on water power since 1920 has led in Austria to the building, of four power stations at Mallnitz, Steeg, Stuback and Spullersee, with an aggregate capacity of 89,000 horse-power. The water power already developed in Austria amounts to 582,000 horse-power, 213,000 horse-power in power supply stations and 369 000 horse-power in industrial plant. Water power up to 3.7 million horse-power exist in Austria and nearly one-half of it can be developed at once. In 1923 about 220,000 horse-power was in operation and 69,000 horse-power projected, leaving about 1.4 million horse-power to be developed. Of the known water power in Austria, only 13 per cent. is in operation and 4 per cent. under construction. These figures show that the reconstruction of Austria is very largely a question of utilising more water power. Austria's coal resources amount to about 400 million tons, equivalent to forty years' supply, so that the question of power has become very urgent for her.

In Franch and Italy, the high post-war prices of fuel have pushed on electrification very rapidly in those countries. In France, the *régime* of railway and agricultural electrification based on water power rather than on fuel has begun. The Paris–Orleans line is using the water power of the Massif Central while the P.L.M. is working on the power derived from the Alps; the Midi has been exploiting the northern slopes of the Pyrenees. M. de la Brosse, in his *Rapport sur les Forces Hydrauliques en France*, describes in close detail the present stage of development, and the methods by which it is hoped to harness completely rivers like the Durance, the Rhone, the Isere, the Dordogne and the Rhine. The actual water power available in France lies in the neighbourhood of 6 million kilowatts, 1 million of which is actually used, 800,000 kilowatts being absorbed by industry. Professor G. de Marchi, in his *General Report on the Power Resources of Italy*, treats historically the evolution of water power in Italy, and shows how the great industrial centres in the north of Italy arose as a result of power transmission from the Alps to Milan and Turin. Long-distance transmission solved the power problem for Italy, and made it one of the first countries in Europe in electrical transport. The exploitation of water power on a large scale is now being carried out in Apulia, Calabria, Sicily and Sardinia; a result of this may be the first great movement towards restoration of deserted Calabria to one of the most valuable provinces of Italy. Italy, on one side of the Alps, France on the other, and Austria on a third side and Switzerland on the fourth, have made of this block of mountains one of the greatest power regions in the world.

The Swiss report, compiled by four authorities—J. Buchi and H. Eggenberger (both responsible for the electrification of the Swiss Railways), Dr. A. Strickler and H. F. Zangger—shows how far Switzerland has progressed in the use of water power, 60 per cent. of the total resources available now being harnessed for industrial, transport, agricultural and illumination purposes. The effect of this on coal consumption can be seen from the fact that in 1913 3,387,000 tons were imported and in 1922 2,196,000 tons, a reduction of 30 per cent. At the end of 1922 Switzerland was using at least 600,000 horse-power, with an installed capacity of 1,490,000 horse-power, and an annual production of about 2800 million kilowatt-hours. Comparing these figures with British results, it is seen that Britain with nine times the population of Switzerland consumed less than twice the power, the consumption per head of population in the latter being 750 kilowatt-hours and in the former 145 kilowatt-hours.

Central Europe, ravaged by the war and rendered industrially helpless by the provisions of the peace, has come back rapidly to economic restoration simply through the careful survey of the natural wealth left to it and the careful examination of methods by which the last ounce of force may be wrung out of resources. The three reports, *The Power Resources of Hungary*, *The Review of the Natural Sources of Energy and their use in Czecho-Slovakia*, and *The Power Resources of Yugo-Slavia*, show all three countries in a new light. Hungary can command 174,480 horse-power from the Danube and has immense areas which could be used for power purposes, over 500 million cubic metres having been prospected. In addition there are 500 million tons of lignite, 119 million tons of coal, and 430 million tons of brown coal, so that sufficient material is available to revolutionise industry and bring improved methods into agriculture. Czecko-Slovakia, with 8787 million tons of coal, is the most fortunate of the Central European states, and has, in addition 12,434 million tons of lignite. The latter is used almost exclusively for generating power. The amount of water power in Czecho-Slovakia is given as 1,722,000 horse-power, but only about 155,000 horse-power is used.

Two valuable sections were contributed by Russia and Scandinavia, and the picture given of the determined efforts of Russia to reconstruct her whole economic scheme on a power basis will come as a surprise to many who have considered Russia from the political standpoint only. The description given of the great electrification scheme evolved in 1920, whereby Russia was divided into four main industrial districts—the Central, South, Ural and Leningrad—is strengthened by the account of the progress achieved in putting this scheme into practice. Three great power stations, to be equipped for the most part with British machinery, at Nijni-Novgorod, Skatura and Chterovka, are in course of construction, and will be operating early next year.

The theoretical available water power in the whole of the territory of the U.S.S.R. is placed at 62,308,000 horse-power, but of this amount only 830,000 horse-power is regarded as utilisable, since unfortunately the majority of the total available power is in districts where it cannot be put to useful account. The central industrial area surrounding Moscow, for instance, possesses no single source of hydro-electric power capable of supplying as much as 10,000 horse-power. The Caucasus and the mountain districts to the south of Turkestan, on the other hand, abound in water power, which it is intended to harness to supply the oilfields of the Baku district and the increasing cotton-growing districts in the neighbourhood of Tashkent.

There does not appear to be much possibility of harnessing any appreciable amount of the 51,138,000 horse-power shown as available in Eastern Siberia.

In Esthonia water power schemes to the extent of 65,000 horse-power are being undertaken by the Government, while in Finland a total power supply of 1,314,000 horse-power is available, of which 189,700 horse-power is actually being used.

Although Norway has developed only about 12 per cent. of her great and cheap power resources, the water power in Norway has been developed and made accessible for the public utility to a greater extent than in any other country in the world.

The whole of Wednesday was given up to a group of papers connected with The Economic Aspect of Power Resources.

Sir Robert Horne, who presided, said the subject to be discussed was the economic and financial aspect of production and supply, which he regarded as one of the most important of the many topics which would be brought under review. It was common knowledge that as the result of the war Europe was in a state of confusion. Vast sums of money had been destroyed, wiping out the accumulated wealth of past years, and even outside Europe many countries were in a far less affluent state than in former years. It would not be regarded as an extravagant estimate of the present condition of affairs to assert that there was not now enough wealth in the world to maintain the old standard of living in European countries. If the standard of living was to be lowered, that could only be brought about with great difficulty and distress, with which would be associated conditions of unrest. There was only one way out of the situation which had been created by the world war, and that was to increase the wealth of the world by adding to the production of the world. It was the fashion to make comparisons between the state of the world to-day and that which existed after the Napoleonic wars. A recovery from the effects of the wars of Napoleon was brought about by the development of coalfields, the use of steam and machinery, by which it was found possible to create fresh wealth, and indeed not merely to restore the losses of the old war period, but to set on foot a great

progressive movement. Where were we to look to-day for the permanent improvement which would save the world from disaster? The only practical solution of the problem which was in sight was, in his opinion, a great development of electrical power. Europe and the world possessed resources which, if properly utilised, might bring back prosperity to our civilised community. Great Britain, for example, possessed vast deposits of coal which at the present time were being egregiously misused. It should be realised that if the coal resources of the country were converted into electrical energy on a sound technical plan it would be possible to develop three times as much power as was obtained from coal under the existing system. Our methods of using coal were associated with a great waste which could be redressed by the utilisation of existing knowledge. Countries like Switzerland, Sweden and Italy, which for various reasons had been compelled to give more attention to the generation of power, had set an example which should make the British people ashamed. If the power system of Great Britain were compared with that of the United States, this country came in a very bad second indeed. The opportunity to carry out reform was here to-day. He looked for great beneficial results from the World Power Conference. Inspiration might be gathered from an assembly where people from all parts of the world were congregated and who were animated by the same desire to tread a path of progress which would benefit mankind. The co-operation which that Conference would bring about must be of the greatest possible advantage in the solution of the power problem. The settlement of the various questions now at issue involved governments, municipalities, and the organisations which they could initiate, as well as private individuals. The papers which would be presented to that day's conference would indicate the manner in which other countries were dealing with the development of power, and there was opened up a prospect of great material achievement which would unite all countries and all races.

Amongst the papers presented, one by Major-General Sir Philip Nash, is of exceptional interest, for the author takes as his subject *The Economics of World Power*. It is one, he says, which in comparison with the purely technical, has been neglected, but which must be studied intensively, for whilst a stage has been reached where the technical problems may in one sense be regarded as solved, the economic aspects demand much close examination. The more highly industrialised a country becomes, the more varied and complicated become the demands it makes in connection with its standard of living, largely as a direct or indirect result of the greater power resources at the disposal of man and the greater facilities arising out of an extensive use of these resources. Power may be regarded as the mainstay of the modern industrial state and a prime factor in its social development. The social structure itself is, in a sense, bound up with the effective use of power for industrial purposes, and there are many reasons to support the view that the weakness of the social structure in an industrial state is due to inefficient or inadequate utilisation of power.

If one accepts this view, then the relation between existing power utilisation and the power resources still capable of development is of fundamental importance.

In the following table the author exhibits this relationship for several nations in 1920.

World Power in 1920.—The Relation between Potential Power and Power Consumed (Millions of Kilowatt-hours).

Country.	Total energy available.	Power consumed.	Percentage of total power consumed.
			Per cent.
Great Britain	165,000	6,400	3.88
America	584,000	49,802	8.4
France	29,950	5,410	16.7
Germany	143,600	8,600	6.0
Italy	10,582	3,400	32.1
Switzerland	7,513	2,700	36.2
Totals	909,477	76,312	8.36

The three countries, Switzerland, Italy and France, countries with less coal than the remaining three (Britain, America and Germany), have been forced to bring their consumption almost into line with the total energy available. If under an ideal state of affairs Britain or America were entirely electrified, and therefore the power used in every activity was wholly electrical, only a fraction of the coal and oil at present produced would be required to meet their consumption of energy, and this amount would decrease with the greater efficiency of the generating plant installed. It is impossible to estimate entirely what energy would actually be consumed in Britain under a *régime* of perfect electrification, but one can scarcely believe that even one-third of the total energy which could be produced from the present production of coal would be required.

The rate of expansion of power generation and supply during the period 1908–1922 in the three countries for which consecutive statistics are available, America, Britain and Italy, gives an indication of the speed at which electrification has taken place.

Growth of Power Production, 1907–22.

Year.	United States. Production (million kw.h.).	United States. Increase per cent. since 1907.	Britain. Production (million kw.h.).	Britain. Increase per cent. since 1907.	Italy. Production (million kw.h.).	Italy. Increase per cent. since 1907.
1907	5,862	—	713	—	1097	—
1912	11,569	97	1235	71	1961	79
1914	14,400	146	1635	130	2528	131
1915	16,175	177	1694	138	2835	158
1916	21,230	279	2001	181	3571	225
1917	25,438	334	2366	232	3826	250
1918	33,200	467	2716	284	4111	274
1919	38,921	564	3078	331	3826	250
1920	43,555	643	3086	334	4252	289
1921	40,976	600	3677	416	4430	302
1922	52,275	890	3040	328	4550	314

When one considers the total number of units generated in 1921 in four countries, namely, 41,000 million units for America, 4900 millions for Britain, 4300 millions for Italy, and 3130 million units for Switzerland, a total production per head of population of 390 units is found for America, 117 units per head for Britain, 116 units for Italy, and 780 for Switzerland. If an estimate is made of the number of units generated per kilowatt installed, it will be seen that Switzerland, Italy, and America have remained almost on the same level in the neighbourhood of 3000 units, while the British figure is less than 1500 units. This points to the fact that, even with reference to other countries, Britain is unable to get the full power possible out of the stations at its disposal, and that, kilowatt for kilowatt, its generating plant is probably less efficient. The multiplication of small generating stations, even of the very highest efficiency in their class, must lead to this discrepancy, since the large station is in a better position to combine the maximum output of energy with the lowest generating costs. One conclusion which may be drawn bears on the efficiency, and perhaps control, of the generating stations. The difference between 1500 units and 3000 units may actually be a difference in efficiency and distribution, even as much as a difference in load.

SIXTY YEARS AGO.

"IT is years since the guns of an English ship of war have been fired in anger. But it may not be a month before the resources of our Channel Fleet are taxed to the utmost." So we wrote in a leading article in our issue of July 1st, 1864. Trouble was in the air at that time over Prussia's high-handed treatment of Denmark, which country, believing that it would be backed by Great Britain and France, had declared war on its powerful neighbour in the early part of the year. Eventually we escaped any naval or military intervention, but in our leading article, writing without a knowledge of the future, we speculated as to the probable outcome of an engagement between the British and Prussian Fleets. Little more than a week previously the historic action between the Alabama and Kearsarge had been fought "almost within our own waters." Both were timber-built ships—the Kearsarge was provided with a protection of chain armour—and were of equal tonnage. The action was fought at long range. The victorious Kearsarge—we claimed to be the only London paper with the exception of *Punch* which had spelt the name of the vessel correctly—fired but thirty shots to the Alabama's ninety, but the Confederate ship was sunk. It was admitted that the engagement presented features that could not have been predicted, but we argued that it conveyed no important lesson that might be applied to the discussion of the probable results of an action between ironclads or iron armour-plated vessels. We could expect to meet 5in. armour plating and Krupp guns. Possibly we might find turned against us the guns of Captain Blakely—who had been "persistently snubbed" by our own Admiralty. Blakely guns, "the heaviest, the most effective and the most easily managed guns ever made in England" were, there was good reason to believe, at that moment being sent abroad to become the most dangerous weapons that could be turned against us. . . . In a letter to the editor Mr. George Bertram, of Sciennes, Edinburgh, wrote criticising certain statements made in a previous issue by Mr. J. C. Dyer regarding the first steamboat. Mr. Dyer had taken part sixty years or so previously in the trials of Fulton's early steamers on the American rivers, and in his article held Fulton to be the principal beggeter of the steamboat. Mr. Bertram entered the lists in favour of William Symington. Symington, he wrote, undoubtedly propelled a small vessel by means of steam in 1788 on a lake at Dalswinton, Dumfriesshire, and in 1789 produced a much larger vessel which he navigated on the Forth and Clyde Canal at a rate of five miles an hour "with perfect success." The experiments on the same canal for which he is now held in esteem were begun in 1800 and reached maturity in 1803. Mr. Bertram gave extracts from a book published by Symington at Falkirk in 1829, in which he stated that both Bell, of the Comet, 1811, and Fulton, who sailed his boat on the Hudson in 1807, visited him when he was carrying out his experiments on the Forth and Clyde Canal. Fulton particularly was afforded every opportunity to examine the steamboat and took liberal notes regarding the form, size and construction of the vessel and her steam apparatus. Mr. Bertram stated that Mr. James Blackie, late of Pannure Foundry, Edinburgh, who was still alive, had assisted Symington in his later experiments and could bear testimony to all connected with them.

Indicating High-speed Engines.

WITH the object of removing the difficulties of indicating high-speed engines with the ordinary mechanical indicator, the apparatus which is illustrated herewith has been devised. It is simply a valve which opens the passage between the engine cylinder and the indicator cylinder for a very small portion of a stroke, but each successive opening is a little later in the stroke than the preceding one, so that if a large number of cycles be taken a succession of dots lying close together on the expansion curve are given.

The Juhasz valve, as it is called, is mounted upon the

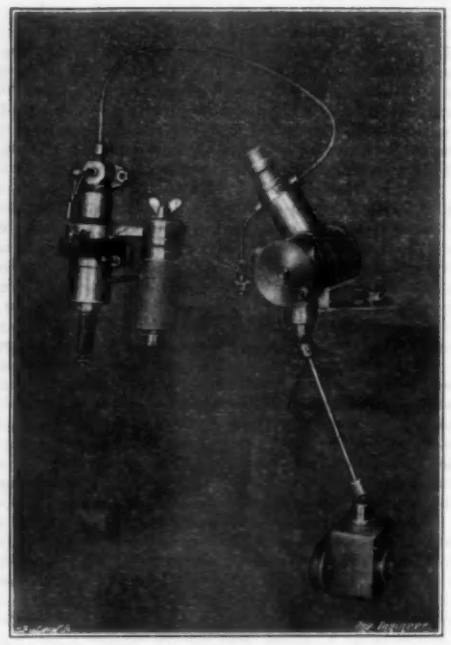


FIG. 1

engine, as seen in Fig. 1. It consists essentially of a pair of slide-valves operated by cranks at 180 deg. to each other. The object of using two cranks is to make the relative motion of the two slide valves very rapid, so that the passage through them may be opened momentarily. The passage joins up I and M—Fig. 2—of which one is coupled by a pipe to the engine and the other to the indicator. The crank shaft of the valves is driven by a cardan shaft from the engine crank shaft through the universal joint W. The spindle of W carries a worm, which rotates a worm wheel which in turn drives a wheel provided with a crank pin, to which the indicator cord is attached. The speed of this pin is $^1/_{360}$ of the engine speed, so that three hundred revolutions of the engine

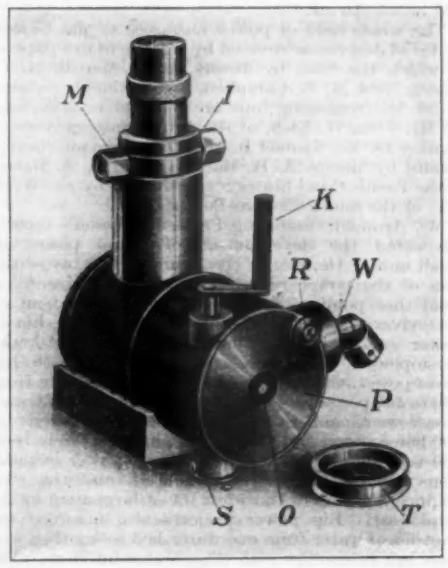


FIG. 2

are required to complete the card. Between the worm wheel and the shaft operating the pair of slide valves is a reducing gear, which causes the speed of the crank shaft to lag slightly, so that the valves open at a different part of the stroke for each revolution. The result is that a diagram is built up in stages, but the appearance is almost exactly that of an ordinary card. The instrument is being put on the market in this country by the Lunken Company, Limited, of Great Dover-street.

SULPHUR production in Japan during 1923 amounted to 35,125 tons, an increase of 6½ per cent. as compared with 1922.

The Royal Agricultural Society's Show, Leicester.

No. II.

THIS is the third occasion on which the Royal Agricultural Society has held its annual Show at Leicester, the last time being in 1896. The site of this year's event is on land adjoining Abbey Park, exactly one mile from the centre of the town, and the show yard is about 140 acres in extent. A great deal of preparatory work has had to be done on the ground to make it suitable for the purpose of such a vast undertaking. The land was originally undulating pasture, and in order to make a more attractive appearance for the front entrance, a considerable amount of excavation work has had to be carried out for the approach roads. In plan, the show yard is somewhat irregular, and the main avenue, which is usually a feature of the ground, has this year been dispensed with.

The section devoted to machinery and implements is rather less in size than that at Newcastle last year, and considerably less than at Leicester in 1896. The principal reasons for the falling off are no doubt two-fold, first, the British Empire Exhibition at Wembley, and, secondly, the depression which still prevails in the agricultural engineering industry. Still, all things considered, the display is one which the Society need not be ashamed of. There are 455 stands in this section, necessitating the erection of 11,500 lineal feet of shedding, besides a number of "open space" exhibits. There is also a slight falling off in the number of entries for the Society's Silver Medals, of which there are only thirty-seven. Although prizes to the value of £15,360 are offered in other sections of the Show, no inducements in the form of competitions for prizes other than the medals have been offered to implement exhibitors, and many years have elapsed since the Society has organised tests such as those in connection with the internal combustion engine that created so much attention.

Forestry is an industry that has come much to the fore since the war, owing to the great drain which was made during the war period on our woods and forests. The forestry section at Leicester is of particular interest, because the Forestry Commissioners have arranged a general exhibit which illustrates the growth of a tree from the seed to the final timber product. Engineering does not enter very markedly into forestry operations, but the Foresters' School, Park End, Lydney, Gloucestershire, is showing a drilling machine for use on 3ft. seed beds, which sows the seeds in drills 4in., apart across the bed, *i.e.*, at right angles to the direction in which the machine travels. It is designed for use in forest nurseries of large size where the amount of seed, especially conifers, is considerable. The exhibitors claim that with this appliance one man can sow a 30-yard by 1-yard seed bed in about 6 minutes, as the machine makes the drills, deposits the seed in them, and covers the drills all in one movement by simply turning a handle.

The entries of live stock, poultry and produce are in excess of those of last year, the total being 3975 horses, cattle, goats, sheep and pigs, 1157 head of poultry, and 300 exhibits of produce. The grand total is about double that of the previous Leicester Show.

The exhibits of the National Gas Engine Company, Limited, of Ashton-under-Lyne, comprise several engines of medium and small sizes for operating on crude oil, suction gas, petrol or paraffin. The largest exhibit shown is a horizontal gas engine of 50 maximum brake horse-power using producer gas. This engine has been specially designed for the overseas market, for which purpose it has a larger cylinder than standard with a relatively higher output and little increase in weight. In other respects the engine is of this company's standard design, embodying a girder bed, well-supported cylinder with a loose liner of hard cast iron, a balanced crank, and electric ignition with variable timing gear. The lubrication is by means of positive pump. There is also on view a 30 brake horse-power heavy oil engine, designed to start from cold without preheating of any kind. The special features of this engine are the fuel pump, the atomiser and the breech end. For starting purposes there are a small compressor and an air receiver.

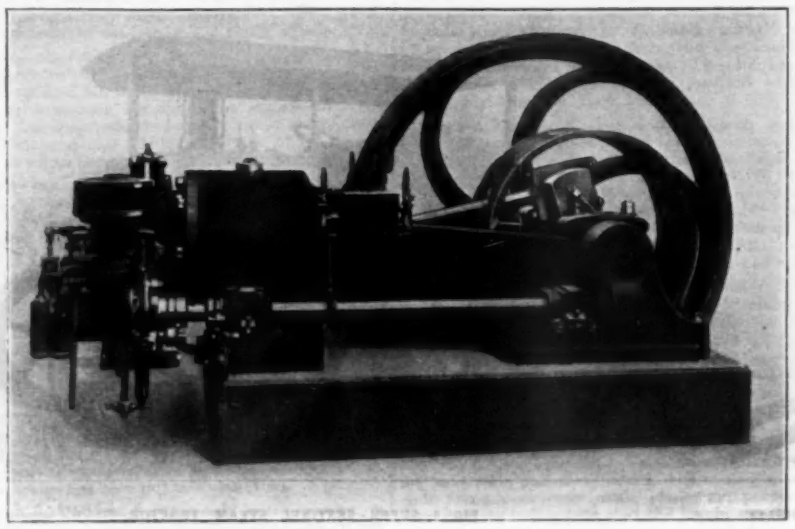


FIG. 1—30 B.H.P. HEAVY OIL ENGINE—NATIONAL GAS ENGINE COMPANY

We gave a sectional view of this engine in our third article on the British Empire Exhibition, published on May 9th. We now give a general view of the engine in Fig. 1. It has a single cylinder 10in. diameter by 18in. stroke, and gives its full output at a speed of 250 revolutions per minute. The general design of the engine follows this company's customary practice. The fuel valve occupies a central position in the combustion chamber. The fuel pump is of the constant stroke type, the amount of fuel delivered to the valve being controlled by the governor, which by-passes the oil back to the fuel tank at light loads.

Among the smaller exhibits by the same firm there is a 3-kilowatt horizontal lighting set, of which we give an illustration in Fig. 2. This engine is designed for operation on town's gas, petrol, alcohol and paraffin, and combines the advantages of the low-speed engine with the relatively cheap high-speed generator. The bed of the engine is made on the girder principle. It carries the two bearings for the crank shaft, and also supports the electrical generator, the latter being driven by chain gearing. This engine is of the firm's standard type with a centrifugal governor and magneto ignition operated from the side shaft by means of an excentric and with variable spark timing. This type of engine is made in five sizes from 1½ kilowatts to 7½ kilowatts capacity.

Fielding and Platt, Limited, Gloucester, show three sizes of engine of the hot-bulb type, namely, 48 brake horse-power, 38 brake horse-power and 14 brake horse-power. These engines are of the 4-cycle type, the amount of power developed being regulated by the governor which controls the cut-off valve fitted to the oil injector, the supply of oil being cut off earlier or later during the stroke according to the load on the engine. The atomiser is a plain hole fitted with a non-return valve of simple construction, and the oil injector consists of a pump actuated by a quick-acting ram. The valves are of the mitre type, the exhaust valve being fitted with a renewable guide which is lubricated specially. The inlet valve is of mild steel and seats in a cast iron housing fixed above the exhaust valve. The cam shaft is driven off the crank by means of spiral gear wheels, and is carried in three long gun-metal bushed bearings. The cylinder is lubricated by a force pump and the main shaft bearings are ring lubricated. The crank pin is lubricated by means of a centrifugal oiling pin bolted on the crank shaft, the oil being conveyed to the bearing by means of a hole drilled in the crank web. For all engines from 38 brake horse-power upwards a positive high pressure compressed air starting mechanism is provided.

The Sentinel Wagon Works, Limited, Shrewsbury, has an interesting stand on which it shows a steam omnibus, a tractor, a three-way tipping wagon, and a portable steam plant. It is claimed that the last named is the lightest portable engine on the market. It weighs complete with boiler and accessories 3 tons 12 cwt., and it is capable of developing up to 60 horse-power. As will be seen from the illustration—Fig. 3—the engine is identical with that on the Super-Sentinel wagon. It is totally enclosed and automatically lubricated by means of a large sump in the crank case, as well as by means of an automatic cylinder lubricator. The engine has poppet valve gear, which is fully adjustable for wear. The makers claim that this engine is extremely economical, using only about 22 lb. of steam per brake horse-power per hour. The boiler is similar to that fitted on the steam wagon and of the water-tube type. It can be opened up by dropping the fire-box and without breaking any external joints whatsoever. It has no stay tubes or screwed tubes, the tubes being simply expanded into place. The boiler is fitted with a fusible plug, which protects it against danger due to low water and excessive steam pressure. The fire-box is adapted from and forms an enlargement of the internal fire-box as fitted on the steam wagon boiler, giving an increased combustion space, which allows of any kind of fuel being burned. Nearly all the spare parts for this portable plant are similar to those on the Super-Sentinel steam wagon, and are easily procurable from this company's service depôts. The steam tractor shown by the same firm consists of a standard engine and boiler mounted on a very short chassis. In the steam tractor exhibited—Fig. 4—patented road wheels, which can be quickly converted for either rubber or steel tires, are used. The tractor may also be fitted with standard tires,

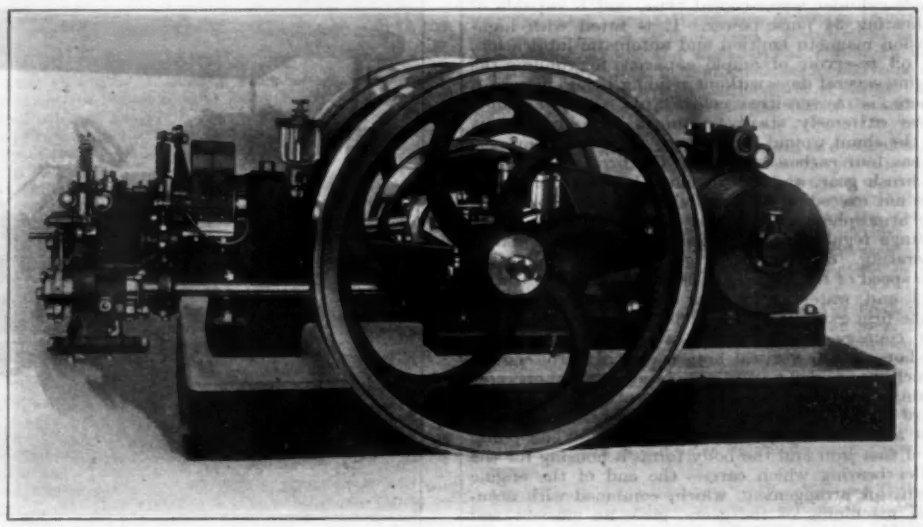


FIG. 2—3 KILOWATT CHAIN-DRIVEN LIGHTING SET—NATIONAL GAS ENGINE COMPANY

wagon wheels for high-speed road work. It is also made double geared for ploughing and extra-heavy haulage work, the capacity being 20 tons up a gradient of 1 in 10.

In our description of exhibits at the Royal Show last year we referred to the new system of soil preparation introduced by Simar Rototillers, Compton-street, Goswell-road, London. By this system, the various tillage operations are replaced by one single operation consisting of "biting" the soil along its line of least resistance to the depth required. This year a new rotary soil tiller is shown for attachment to existing tractors. This implement, which has been entered for the Society's silver medals, has been designed for application to the "Fordson" and the

* No. I. appeared June 27th, 1924.

"International Junior" tractors. The implement is driven by belt and chain on the "Fordson" and by chains only on the "International Junior," and can be attached to the tractor without mechanical alterations to the tractor, in less than half an hour.

The general design and principle of the rotary tiller attachment for tractors is similar to the other existing types of Rototillers. It consists of a "miller," which is a power-driven transverse shaft fitted with electrically mounted tines turning at the rate of 250 revolutions per minute, tearing the soil and leaving behind a ready prepared level seed bed. The width of the "miller" can be instantly altered by adding or removing the elements. The minimum width is 3ft. 4in. and should be used for deep tillage. The medium width is 4ft. 5in., and will find its uses on medium soil. The maximum width is 5ft. 5in., and is intended for shallower cultivation, replacing all the existing harrows and cultivators for stubble cleaning. The surface tilled varies according to the speed of the tractor and the width of the miller. The controls are simple, and consist exclusively of a clutch lever to disconnect the miller at the end of a field, while turning and to re-engage it again after turning without stopping the forward motion of the tractor. Hand wheels acting on the travelling wheels regulate the depth of cultivation.

R. A. Lister and Co., Limited, Dursley, Glos., show a neatly designed direct-coupled electric lighting plant with a capacity of 1.5 kilowatt in which the engine and dynamo are direct coupled by means of a flexible leather disc coupling, the whole being mounted on a cast iron base. The engine is of the vertical single-cylinder water-cooled type, and is capable of indicating 3½ horse-power. It is fitted with high-tension magneto ignition and automatic lubrication, an oil reservoir of ample capacity for running the engine several days without refilling being provided. There is a sensitive centrifugal governor which gives extremely steady running. The dynamo is of the shunt-wound 4-pole type with ball bearings; it has four carbon brushes in the firm's latest type of brush gear, and the machine has a temperature rise not exceeding 72 deg. Fah. above the surrounding atmosphere after a long run on full load. The voltage regulation is effected by a hand regulator operating on the engine governor and regulating the speed of the engine. The plant is complete with fuel and water tanks and efficient silencer. The same firm exhibits a neat little pumping set suitable for country houses and estates. It comprises a 2½ horse-power vertical hopper-cooled petrol engine, which runs at 600 revolutions per minute and operates a single ram pump by means of gearing. The pump is of the single-acting type with a brass ram and has an air vessel on the delivery side. The pump is of cast iron and the body forms a housing for the roller bearing which carries the end of the engine shaft, an arrangement which, combined with accurate machining of the gears, gives an efficient and quiet form of drive. The pump is provided with a crank shaft with main bearings at either side of the crank, the bearings being substantial and furnished with lubricators. The pump valves are of rubber fitted with brass flanges, and the valve seatings are of Muntz metal, which are removable. The ram operates in a packing gland secured by four bolts to ensure equal adjustment and prevent leakage. With an engine speed of 600 revolutions per minute the pump makes 80 revolutions. The ram is 4½in. diameter and has a stroke of 4½in., the output being 1000 gallons per hour to a total head of 100ft.

Advocates of surface or shallow sowing of corn and other seeds will be interested in an appliance shown on the stand of Mr. Sidney C. Darby, Wickford, Essex. The appliance is called the "Multipotent" coulter and is a combination which consists of a disc preceding the sowing coulter to cut up the clods and so prepare a clear way. The disc is followed by "coverers" which cover up the seed and leave the land level thus, incidentally, dispensing with the operations of harrowing in or rolling in the seed. At the back of the coulter frame are two adjustable wheels which span the row of sown seed and govern the depth of sowing to about ¾in. The coulter is triangular in shape, is 4in. wide overall and distributes the seed evenly on a track of 3½in. This appliance is specially recommended for sowing peas, beans, swede, turnip and mangold seed. Mr. Darby also shows a new milk measure, and the sub-soiler, which is constructed for attachment on any of the standard ploughs, whether drawn by animals or by tractor. This simple attachment was awarded one of the R.A.S. silver medals at the Cambridge Show in 1922.

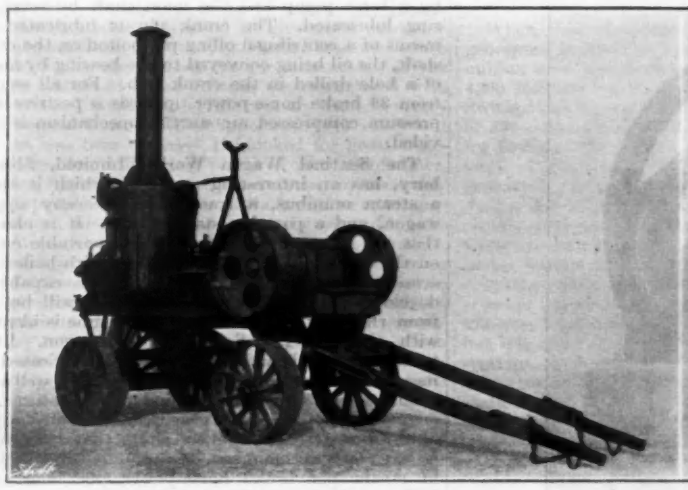


FIG. 3—SENTINEL PORTABLE STEAM WAGON AND BOILER

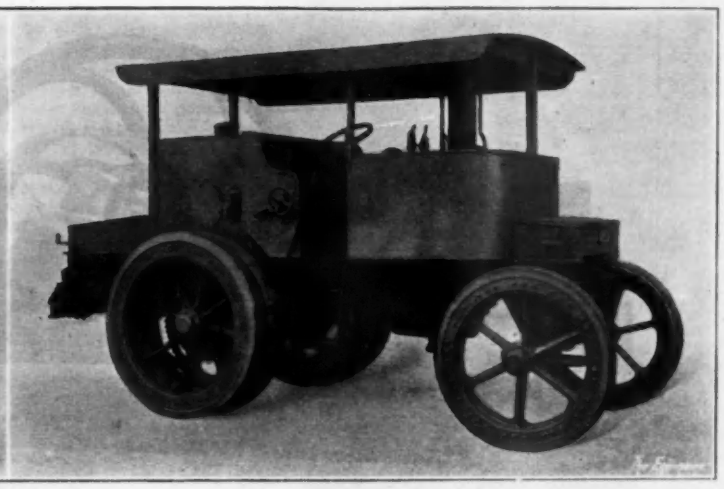


FIG. 4—SUPER-SENTINEL STEAM TRACTOR

The Haslam Foundry and Engineering Company, Limited, Derby, shows a small self-contained mechanical refrigerator which works on the ammonia compression system. The complete plant comprises a compressor—which in this instance is driven by a Lister oil engine—a condenser and the cooling arrangements inside the chamber. The condenser is of the contraflow pattern, made of solid drawn piping and welded in one unit with the oil separator and liquid ammonia receiver in order to eliminate all joints that are subject to pressure. Although the normal working pressure is only about 100 lb. per square inch, this plant is tested to about 3000 lb. per square inch by hydraulic pressure and to 1500 lb. by compressed air in order to detect any porosity, so that leakage of ammonia is practically impossible. It was noted that all connections are made from solid-drawn steel pipe with steel flanges or unions. No screwed joints are fitted in any parts where ammonia is used. The makers claim for this system: (1) that used in conjunction with their machines, the air in the chamber is maintained sweet and dry; (2) that there is no more tendency for moisture to form on the insulation than there is in a chamber fitted with a fan; (3) that the temperature throughout the chamber is perfectly uniform; (4) that the space occupied by the grids is less than that by an air cooler, fan, and air trunks; (5) and that the cooling grids are accessible for cleaning and painting. These plants are specially suitable for use in hotels, restaurants and tradesmen's shops, and the makers claim that the cost of operating a chamber of 175 cubic feet capacity is only about five shillings per week.

Sir W. G. Armstrong, Whitworth and Co., Limited, Great George-street, Westminster, are represented by roadmaking machinery, electric lighting plants, agricultural engines, and pneumatic tools. Although there is really nothing new in the electric light plants shown, the various arrangements are well worth the attention of prospective purchasers. The engines are of the vertical type with the working parts totally enclosed. The engines are shown direct coupled to electric generators or arranged to drive the latter by means of belt. In the semi-automatic sets the dynamo and engine control the current supplied to the battery to suit its condition, thereby rendering damage to the plates impossible. A simple relay is fitted which gives the signal when the battery requires re-charging. The engine can then be re-started from the battery by bringing the starting lever to the correct position. The semi-automatic switchboard is completely enclosed in a metal casing in which the ammeter reads both the charge and discharge, while the voltmeter and the high and low-voltage relay are all visible through glass panels. The high-volt relay is designed to shut down the plant automatically when the battery is fully charged, and the low-volt relay indicates when re-charging is necessary.

Wallis and Steevens, Limited, Basingstoke, show an improved steam road roller, in which an equal distribution of the weight over the whole road surface is effected. By means of a rear axle mounting the rear rollers automatically adjust themselves to the surface of the road, whether flat or cambered. By means of a patented locking device embodied in the fore-carriage the front fork can at will be locked so that the front roller is maintained in a relative plane with the hind rollers, an advantage when working in straight sections. When rolling curves or at junction points the fork can readily be unlocked and the rollers have freedom of movement in all directions. The boiler is of the locomotive form and the engine is of the double-cylinder balanced type. The transmission throughout is by spurred gears and two rates of road speed are provided. The steerage is by means of a worm and quadrant.

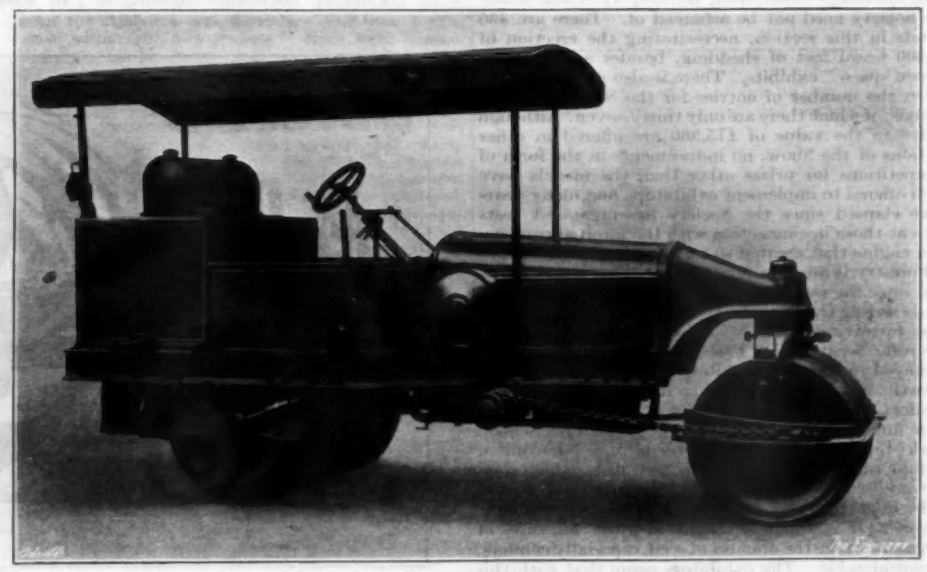


FIG. 5—7-TON MOTOR ROAD ROLLER—RUSTON AND HORNSBY

Railway Matters.

SPEAKING in a debate on the recent strike, Mr. Shaw, the Minister of Labour, said last week that, short of compulsory arbitration, which they refused to propose, the Government already possessed every power that was necessary.

As the first portion of the 4.15 a.m. East Coast express from Edinburgh to Aberdeen was running between Monifieth and Carnoustie on Saturday morning last, the seven rear coaches were derailed. The train was travelling at a high rate of speed, but there were no serious personal injuries.

IT was recently announced in the Legislative Assembly that the Government of India would not come to any definite decision as to the future of the East Indian and the Great Indian Peninsula Railways until the question of the separation of the Railway Budget was settled, which would be done in the autumn session.

ANSWERING a question on June 24th as to railway companies being compelled to provide footbridges over dangerous level crossings, Mr. Gosling said that he could not undertake to introduce legislation as suggested. The Minister of Transport added that the provision of footbridges at level crossings would usually be of the nature rather of a convenience than of a necessary precaution.

IN the July issue of the *Locomotive Journal*, the organ of the Associated Society, Mr. Bromley says: "Fortunately, a great change has been experienced ever since our conference. The companies now not only state that no men have been removed, but undertake that no removals shall be made in connection with classification. This removes much of the soreness created, but as the principles still remain, the issue of the ballot remains with our members."

THE North Seaton viaduct, between Bedlington and North Seaton on the Wansbeck branch of the North-Eastern section of the London and North-Eastern Railway, is a timber structure, 357 yards in length, which was erected in 1859. Owing mainly to coal settlements and the increased axle loads, it has been condemned, and its replacement by a girder bridge sanctioned. In the meantime, in order to limit the weight to be carried, single-line working over the bridge has been put into operation.

THE "Sheffield Pullman," which only began running on June 2nd, is to have its services modified and made to run in the opposite direction as from July 14th. Instead of leaving King's Cross in the morning for Nottingham and Sheffield, and returning to town in the evening, it is to come to London from Sheffield in the morning—leaving Sheffield at 10.30 and Nottingham at 11.23, and being due at King's Cross at 1.45. It will then return at 6.5 p.m., reaching Nottingham at 8.28 and Sheffield at 9.20.

AN announcement made by the Southern Railway reminds us of a paragraph that appeared in this column on November 10th, 1922. It was therein pointed out that when grouping was put into effect the nearest route from London to stations on the London, Brighton and South Coast's line to Portsmouth was from Waterloo, *viâ* Raynes Park, Ewell and Epsom, and that this route would avoid the reverse curve at Mitcham Junction and the stiff climb from Carshalton to Sutton. It is now announced that all the Southern fast trains to and from Portsmouth will be served by Waterloo, and that some will travel by the route indicated above. They will do the journey, whether by Guildford or Horsham, in 1¼ hour.

IN view of the Railway Centenary in September, 1925, the Railway Companies' Association has invited the members of the International Railway Congress to visit Darlington on July 3rd of next year. There will, in that connection, be an exhibition of interesting railway relics which will be on view for about a fortnight. It may be remembered that at the Rome meeting in April–May, 1922, the International Railway Congress accepted the invitation of the Spanish Government to hold the next meeting in Madrid in 1927. Because next year will see the centenary of the first public passenger-carrying railway, this arrangement was subsequently modified, and a meeting in London in 1925 was determined upon, and the visit to Madrid postponed until 1930.

WHILST the results of the hearings before the Railway Rates Tribunal as to standard charges will be of prime importance, the proceedings themselves have been most tame, so much so that we have not thought them of sufficient interest to report. The railway companies have now, however, completed their case, and last week their counsel made the suggestion—which was agreed to—that the companies should formulate a series of submissions in respect of the points involved at that stage. They would submit them to the traders and try to reach an agreement, and, where necessary, the traders should add their submissions. Both parties would consult with the Ministry of Transport and come to the Tribunal with as nearly as possible a series of agreed submissions for its decision.

THAT grouping would lead to some railway manufacturing and repairing works being closed was inevitable. The latest of these is the Hull and Barnsley's Springhead Works at Hull. As to this, Mr. Gosling stated recently that he was aware that the company proposed to close down the Springhead Locomotive Works at Hull, and concentrate at its Darlington works the locomotive work in the company's North-Eastern area. The company, he continued, had stated that it had endeavoured to secure that these arrangements, which had been in contemplation since the amalgamation of the Hull and Barnsley Railway with the North-Eastern Railway in 1922, should be carried out so as to involve as little hardship to individuals as was possible in the circumstances, and that positions would be found for all of the apprentices. The company realised that there were difficulties connected with the housing question, and the men who had been offered positions in another town had been promised the payment of a lodging allowance for a period, together with free conveyance by rail of their household furniture. There were, however, about eighty men who had joined the company's service within quite recent years, for whom, so far as could be seen at present, the company feared it would not be able to find vacant positions.

Notes and Memoranda.

IT has been agreed by the manufacturers, distributors, and consumers of steel hot-water tanks in America, to adopt only 13 different sizes in place of the 130 sizes in vogue. The tanks are also to be made for only two pressures, viz., 65 lb. per square inch and 100 lb. per square inch.

AFTER rising almost continuously during February, March and April, the general level of wholesale prices in Germany took a downward turn in May, and the official Index Number of 118.4 returned for June 3rd is the lowest since February 5th, when it stood at 113.9. The decline in May was spread over all groups, and appears to have been due largely to money market conditions.

THE elaborate experiments made by the *Radio Austria* recently to test a new transmitter at the Deutsch-Altenburg station for rapid telephonic transmission to British Broadcasting stations in England, proved successful. Clear answers were given from the north, central, and south of England and Wales. The longest distance over which a message was transmitted was between Vienna and Bramley, 1600 kiloms.

DURING the fiscal year ending March last, 228,016 tons of asbestos were exported from Canada, as compared with 168,586 tons during the previous fiscal year, the values being 6,678,164 dollars and 7,107,046 dollars respectively. In 1923 more asbestos was mined than ever before, but the value of the product was low and profits were unsatisfactory, owing to a falling off in the demand from Germany and Australia. Before the war those two countries consumed about 80 per cent. of the asbestos mined in Canada.

IN the course of a lecture on the Storage of Silica Refractories, read before the Institution of Gas Engineers, Mr. W. J. Rees said that a batch of silica bricks which had been stored in the open for six months—October to April—spalled badly in use, whilst normal freshly delivered bricks of the same make, and having the same texture, specific gravity, &c., were satisfactory. The good bricks had a cold crushing strength of 3000 lb. per square inch, whilst that of the stored bricks was only 2200 lb. per square inch. The bricks in both tests were dry and were placed on end in the testing machine, the ends being previously made plane and parallel. There were definite indications that the loss in strength of silica bricks exposed to weather was in part due to a slight degradation of the bond by hydration and solution in water, as well as to the physical effect of frequent wetting and drying.

CHILI has a climatic condition which introduces many problems for transmission-line engineers. On the 87-mile 110,000 volt-line of the Chili Exploration Company insulator problems of an interesting character are encountered. Near the coast the Pacific swell causes salt mist to be carried inland by the prevailing winds for 8 miles. The salt spray dries on the insulators during the day and gradually forms a salt incrustration that causes the insulators to flash over when moist. To obviate the trouble the insulators are washed every two weeks. Growing tired of this, the company attempted to operate without washing, but was forced to renew the practice because of flashovers. In spite of these conditions the line has been in continuous service since 1915 with only momentary interruption and delivers 40,000 kilowatts successfully over the No. 3/0 conductors, which were designed to carry only 27,000 kilovolt-ampères. A compensating feature of the climate is that lightning, snow and severe storms are unknown.

IN nearly every branch of trade, states the *Board of Trade Journal*, there are opportunities for placing British goods in the Roumanian market. The principal condition for success is that the British exporter or manufacturer should be in as close touch as possible with his customer—for instance, in the motor car trade no determined attempt has yet been made by British makers to compete. Italian and Austrian makers send fairly large shipments of cars to this market on consignment terms to agents. The British maker has not so far done this, and, indeed, there are other methods of entering the market. Such is the reputation of British cars that it would seem possible for them to command slightly higher prices than foreign-made cars of similar type. If a large maker, or possibly two or three makers in conjunction, could set up their own representative in Roumania under such terms as would allow the latter to open a large repair shop, and, above all, if he were possessed of sufficient capital to enable him to employ two or three reliable mechanics well acquainted with the makes handled by their employer, there is every reason to expect that cars could be sold.

AN article by Dr. Garrard in a recent issue of the *Electrician* deals with the use of explosion pots in oil-circuit breakers. The idea of employing explosion pots is to increase the breaking capacity of the switch by generating a pressure which expels the contacts at high speed and at the same time forces oil into the arc and quenches it. Dr. Garrard remarks that the utility of this arrangement has not yet been experimentally demonstrated, especially from the point of view that a very high break speed may have a bad effect in drawing out the arc and increasing the switch factor. To insure the adoption of explosion pots it must be proved either that they decrease the switch factor or the time taken to replace the arc, or both. In considering these points Dr. Garrard shows that the energy liberated by the explosion of the gas formed by the arc energy is more than 50 per cent. greater than the arc energy itself, and that this liberation takes place under unsatisfactory conditions. This explains why the majority of serious oil breaker explosions have been the result of secondary gas explosions and not of the disruptive effect of the arc energy, which is fairly easily dissipated. Advocates of explosion pots give as one of their advantages the possibility of using weak tanks. But it would be very risky, our contemporary states, to use a tank which could not withstand an explosion of the force met with. On the other hand, if strong tanks are used explosion pots are unnecessary and even dangerous.

Miscellanea.

A BLAST-FURNACE using coke for fuel was recently blown in at Nizhni Saldynsk in the Urals.

THE Chinese Trade-marks Bureau has decided to extend the period for registration of trade marks for another six months.

THE Orito Tunnel on the Aomori–Shimonoseki Railway in Japan, has been completed after eight years' work. It is a mile long, but will reduce the distance between Aomori and Osaka by 150 miles.

THE Dublin Port and Docks Board has agreed to contribute £12,500 towards the cost of a pedestrian tunnel under the Liffey. It is estimated that the whole project will cost £60,000. Lifts will give access to the tunnel.

THE new plant of the West Springs gold mine, on the Rand, which was started early in June, has a nominal capacity of 40,000 tons a month. The whole of the ore is reduced to slime by means of single-stage crushing and tube milling.

ESTIMATED to cost £200,000, the scheme for a new pier and pontoon to replace the existing structure, known as Victoria Pier, the landing stage for traffic between Hull and Lincolnshire, has been approved by Hull Corporation Property Committee.

THE cargo passed through the Panama Canal during the last fiscal year aggregated 19,567,875 tons, as compared with 10,881,910 tons in 1922. Vessels of the United States carried 56.6 per cent. of the total, while the share of British ships was 25.2 per cent.

THE Russian Leningrad Iron and Steel Works are delivering the first steam turbine manufactured at the works since the revolution. This turbine, which was ordered for the Omsk electrical station, is said to have given excellent results at the trials.

THE Stoke-on-Trent Council has agreed to join with the Newcastle-under-Lyme and Wolstanton Councils in the purchase of the undertaking of the Staffordshire Potteries Waterworks Company for the sum of £840,000 in cash, and the discharge of the debenture stock of the nominal value of £121,450.

THE Rand Water Board has decided to proceed with the second unit of its water supply scheme, which will provide a further five million gallons a day from the Vaal River. The estimated cost is £318,000. The Board is now inviting tenders for the supply of about 140,000ft. of 22in. and 24in. pipes, valves and specials.

THE management of the New Guinea Copper Mines has announced that pending the installation of the requisite blowing plant, which is being ordered, the furnace at Bootless Inlet has been temporarily reduced to the capacity of the present blowers of about 125 tons of ore daily. It is now running smoothly, producing low-grade matte.

THE Rio Dorado, which was recently launched by the Blyth Shipbuilding and Dry Docks Company for the Thompson Steam Shipping Company, is notable in having corrugated sides, and also the Millar system of longitudinal framing for the decks and double bottom. She is 390ft. between perpendiculars and will carry over 8500 tons deadweight.

THE Yalu Timber Company proposes to erect a new mill of considerable capacity at Changchun which will extend its service zone almost 100 miles westward of the Kirin district, where it put a branch mill in operation some time ago. The area of timberland held under concession by the company is said to contain more than 3500 million cubic feet of lumber.

IN December next the Exhibition of Mining Industries will be inaugurated at Lima, Peru. British firms which manufacture mining and metallurgical machinery and which desire to exhibit their products, are invited to do so, in which case space will be provided free of charge. All inquiries should be addressed to the Consul-General for Peru, 36 and 37, Queen-street, E.C. 4.

IT is understood that the contracts will be awarded early in July for the erection of a large electric power station with an initial capacity of 30,000 kilowatts on a site which has been secured on the Salt River foreshore, about 2 miles from Capetown. It is estimated that the station will take two years to build, and will cost £1,000,000. An immediate start will be made, and the undertaking is likely to absorb much of the unemployed labour in the peninsula.

THE announcement is made by the Board of Trade that for the purposes of the Patents and Designs Acts, 1907 and 1919, the Third Machine Tool and Engineering Exhibition proposed to be held from September 5th to 27th, 1924 (inclusive), at Olympia, London, W., is an Industrial Exhibition. The meaning of the announcement is that the exhibition of new inventions on that occasion will not prejudice the grant of patents if certain conditions laid down by the Board of Trade are observed.

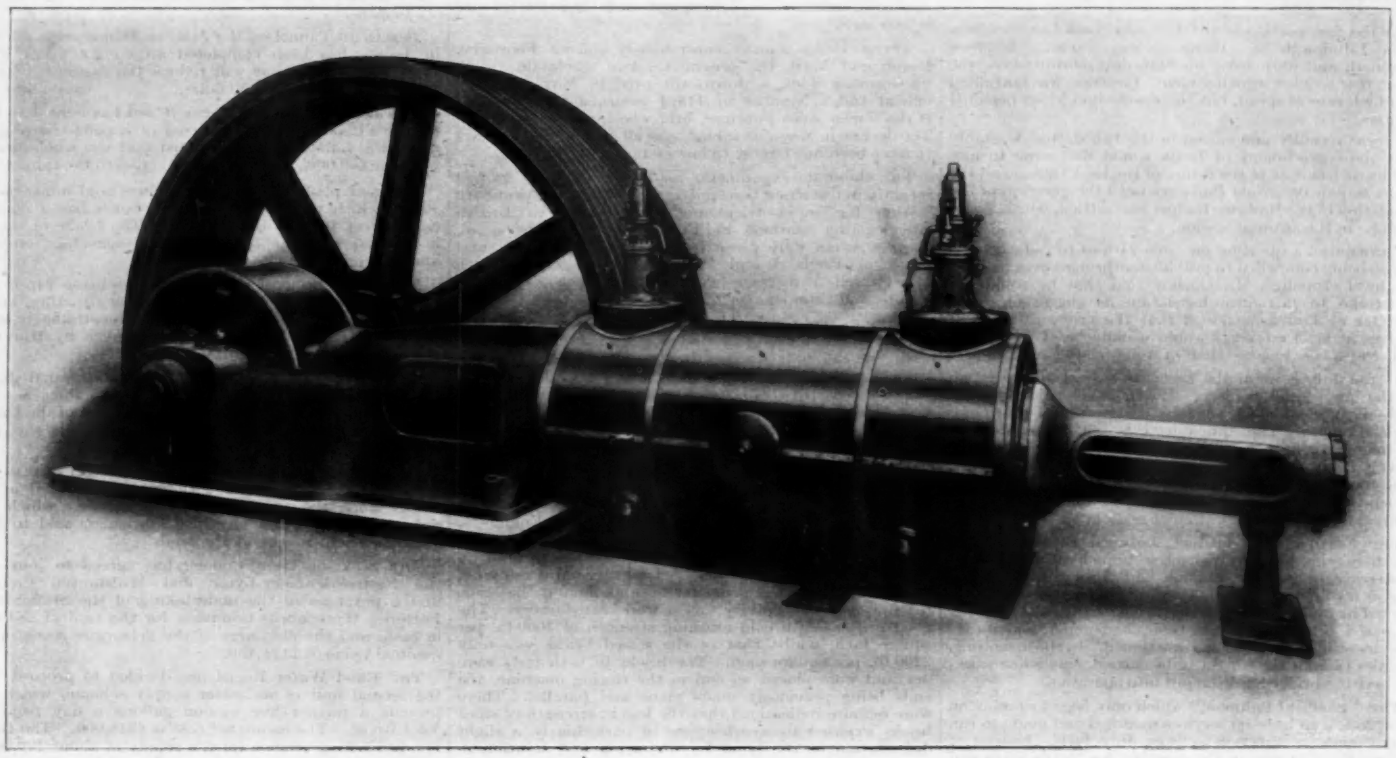
APPLICATION has been made by the Nunnery Colliery Company for permission to work coal under Sheffield. The area affected is about 200 acres of the Silkstone seam, and about 400 acres of the Parkgate seam. The claim has been put forward that the coal is the best bituminous in the land; that its working would result in increased employment; and that if the colliery did not make the application the coal would never be worked, the area being too small to justify any other company sinking shafts.

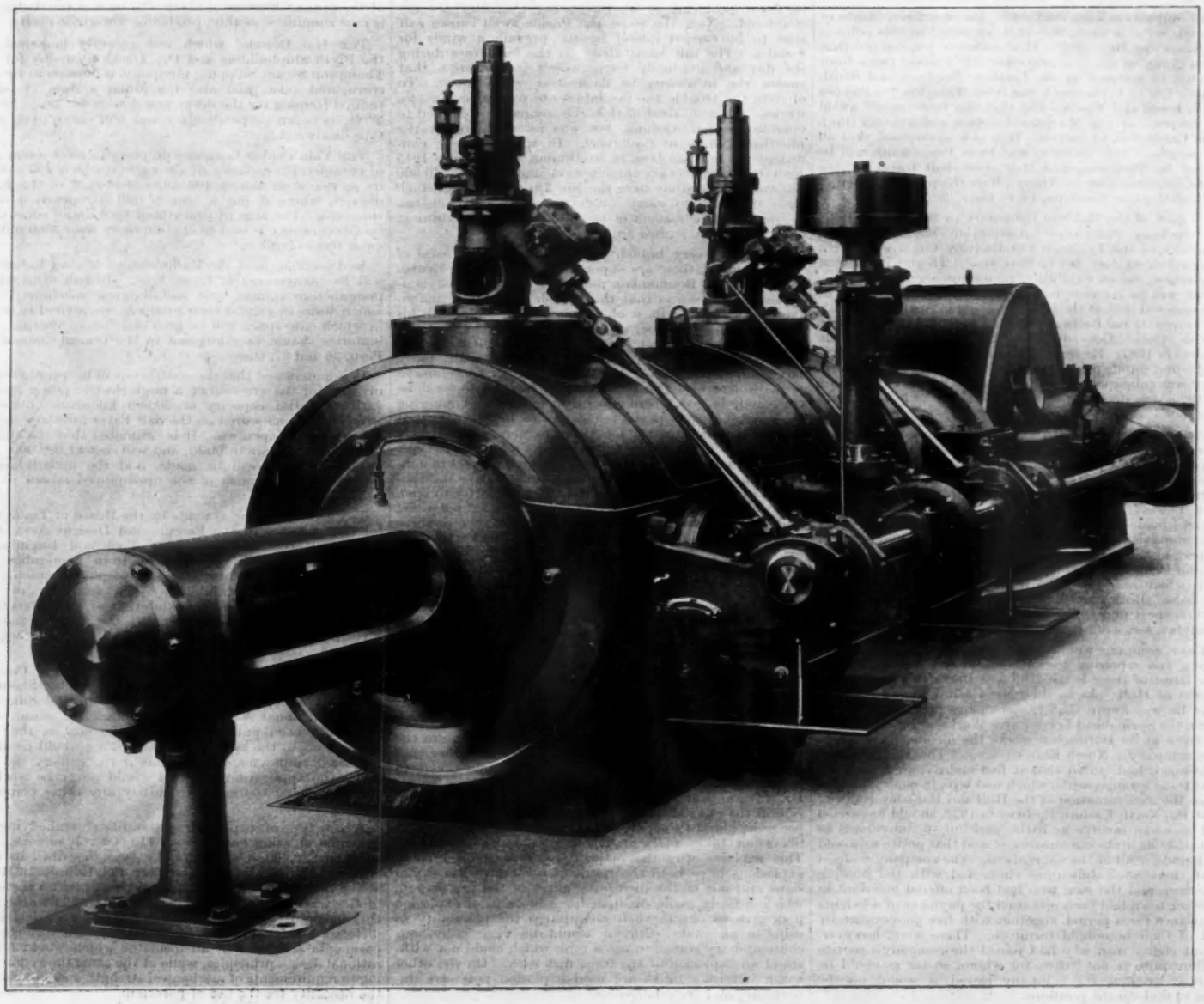
A NEW type of suspension type insulator, embodying the principle of using one unit on 110,000-volt circuits, two units on 220,000-volt circuits, &c., was described by Professor H. B. Smith, of Worcester Polytechnic Institute at the recent district convention of the American Institute of Electrical Engineers held in Worcester. The design of this insulator was made on the basis of an analysis of dielectric fields and the gradual development through experiments and tests of an insulator which would follow rational design principles, while at the same time conforming to requirements of mechanical strength and eliminating the necessity for the use of porcelain.

EMPIRE EXHIBITION—500 I.H.P. UNIFLOW STEAM ENGINE

GALLOWAYS, LIMITED, MANCHESTER, ENGINEERS

(*For description see page 5.*)





EMPIRE EXHIBITION—BISCUIT AND CHOCOLATE MAKING MACHINERY

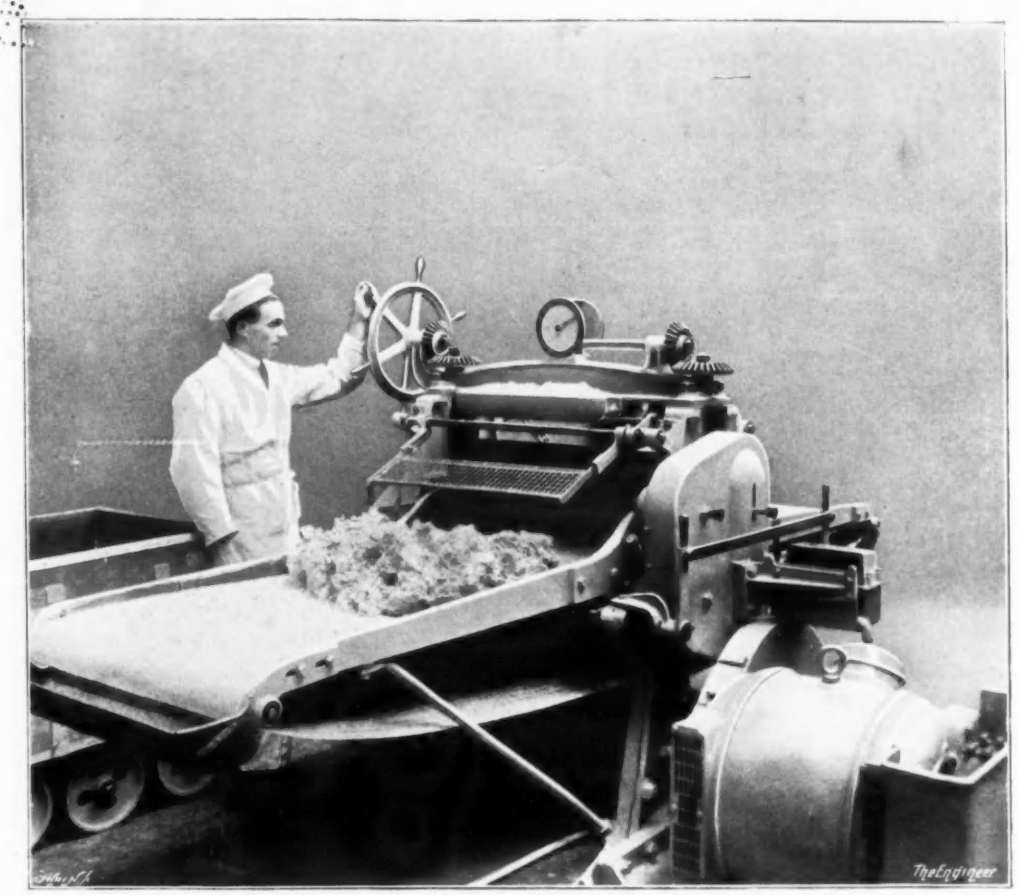


FIG. I. REVERSING DOUGH BRAKE

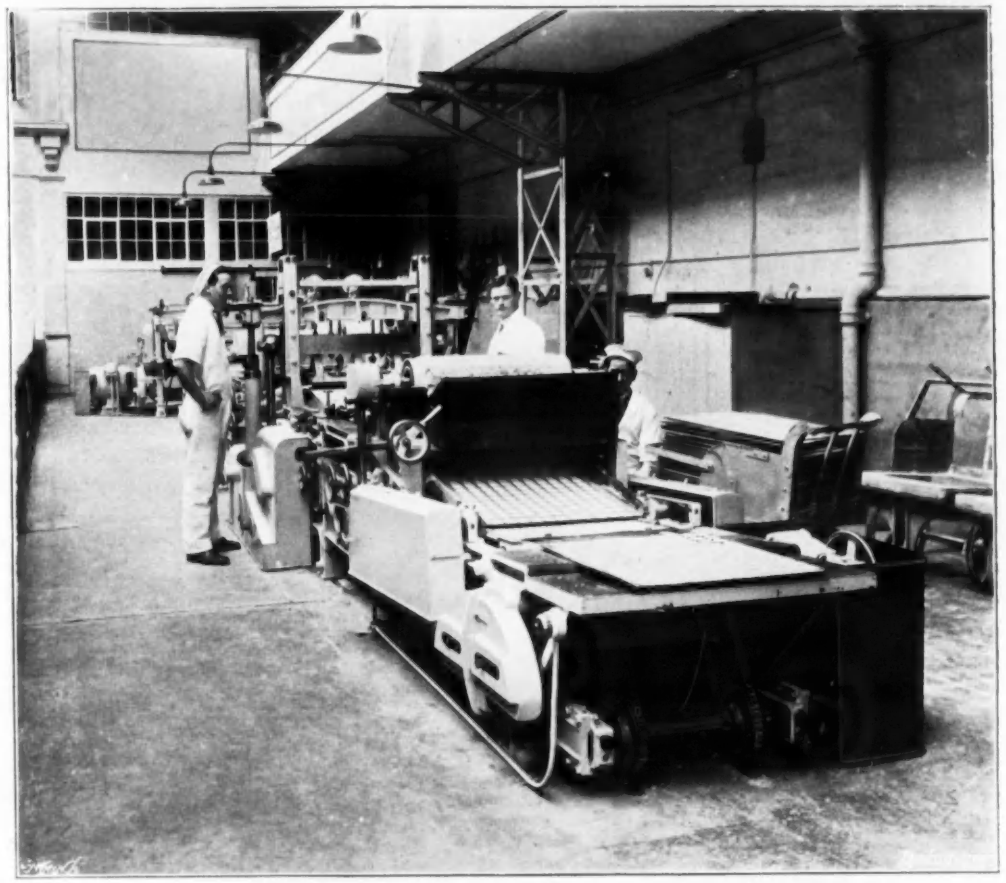
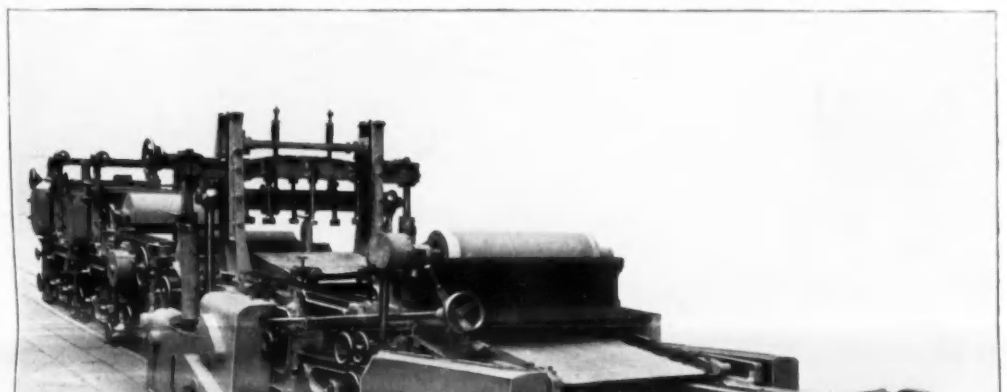


FIG. II. BISCUITS BEING DELIVERED FROM CUTTING AND EMBOSSING MACHINE



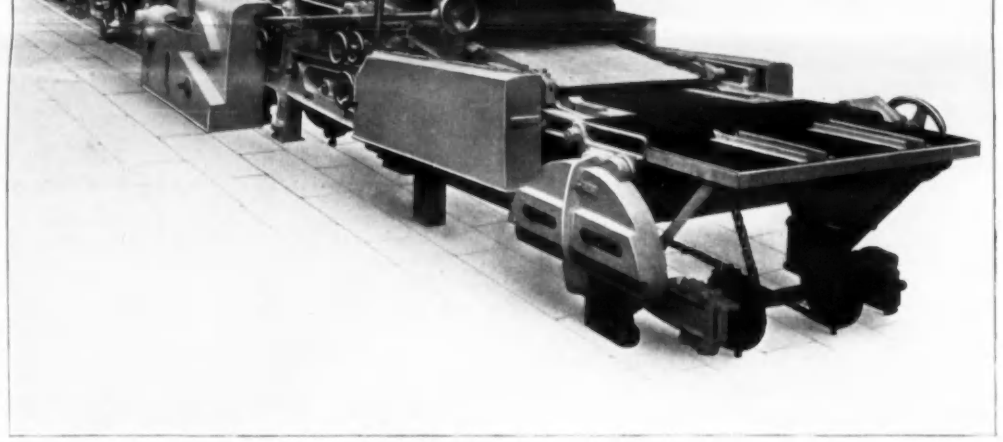


FIG. III.—GENERAL VIEW OF BISCUIT CUTTING AND EMBOSSING MACHINE

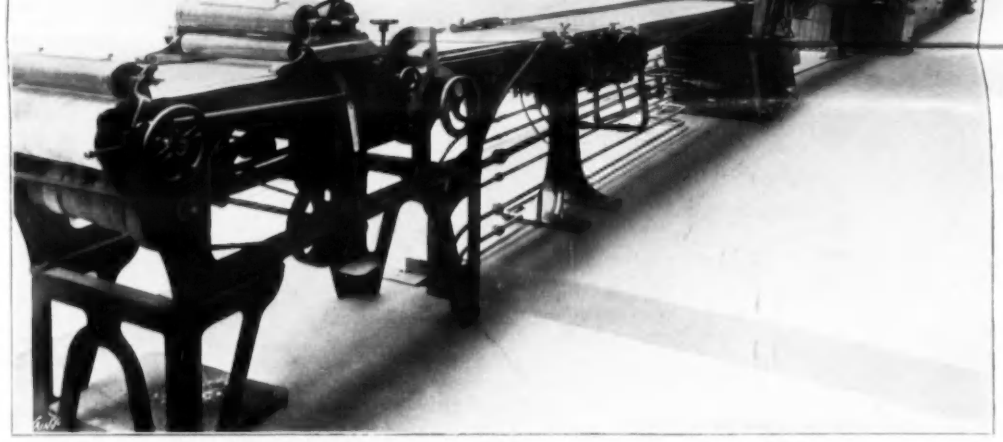


FIG. IV.—CHOCOLATE ENROBER

FIG. V.—TWO-ROW AUTOMATIC BISCUIT OVEN

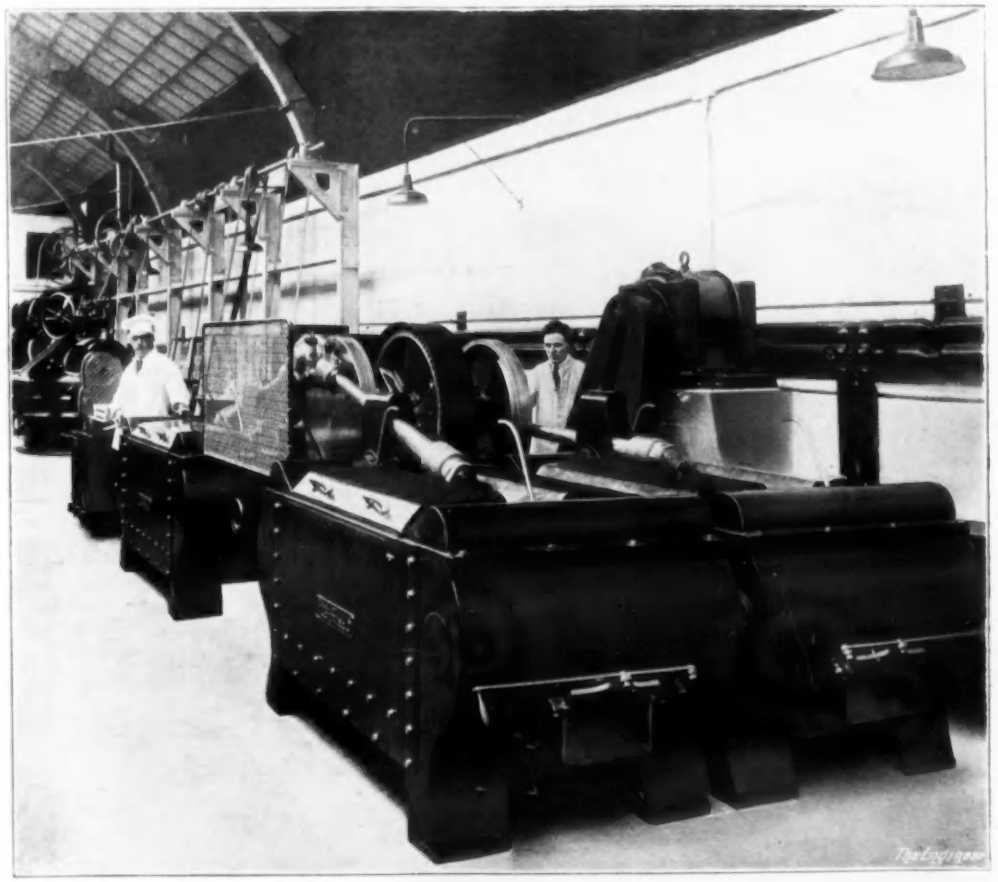


FIG. VI.—CHOCOLATE "CONCHES"

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TWO-PAGE SUPPLEMENT—EMPIRE EXHIBITION—BISCUIT AND CHOCOLATE MAKING MACHINERY.

DEATH.

ON the 30th June, at Bedford, RICHARD JOHN POWELL, late Superintending Engineer, P.W.D., India, aged 62.

THE ENGINEER.

JULY 4, 1924.

The Railway Centenary.

WE begin in the present issue a series of articles on a subject that—usually directly—affects almost the whole of the human race. It is a subject, furthermore, which has a fascination for most men from boyhood to old age. We refer to railways, and on this occasion speak only of British railways. In this country lies the home of the railway system of the world—a heritage which can never be questioned, and of which no other nation can rob us. As will be seen from our first article, railways sprang from wagon or tram ways, and these were used for mining purposes in Germany in the sixteenth century. But it was in this country that rails were first used for the transit of wagons, trams or corves—the vehicles had different names—containing coal from the pit to the side of rivers or canals. They were in use long before the event which occasions the series of articles to which we have referred, but no railway existing prior to the Stockton and Darlington so clearly marked the coming of a new era as it did. It was the first public passenger-carrying railway in the world, and the centenary of its opening on September 27th, 1825, is an event which for many reasons deserves fitly to be commemorated. The benefits railways have brought to the world at large cannot be measured. They are so essentially a part of our very existence, of our trade and commerce, and of our communion with each other, that it is almost impossible now to conceive the state in which we should have been without them. The size to which they have grown and the part they play as users of material and as employers of labour are remarkable. In the railways of Great Britain, *i.e.*, without the Irish companies, up to the end of 1922, the sum of over 1174 million pounds of capital had been invested. During that year the British railway companies spent 178 millions, of which amount over 8 millions were repaid to the public in the shape of rates and taxes. They now employ about 700,000 men, and whilst the amount paid away in wages is not publicly known, it is fairly safe to assume that it approaches over 100 millions a year. Incidentally, the railwaymen have, relatively, the biggest of the trades unions; they certainly have the richest and probably the most influential. To the stockholders, who have provided the before-mentioned 1174 millions, there was paid in 1922 as interest the sum of 52 million pounds. The vast work that is implied in such figures has all been achieved by private enterprise and by the courage and vision of individuals. British railways, with the insignificant exception of two railways in the Western Highlands, have been built entirely by private capital and without any aid from the State. Our railways have never received any assistance or encouragement from the State. Landed interests opposed them strenuously in the early days, and for the expense in buying off opposition and giving the high prices demanded for land which had to be obtained, traders and travellers are to-day still paying. Therein lies part of the explanation why, when compared with other countries, our railways have cost such a high figure per mile to build. Another factor is the greater density of our population and the close contiguity of town to town.

The results that have followed the introduction of railways are really more wonderful than the initial event itself. As we shall show, a railway was built under an Act of Parliament so long ago as 1756, and hundreds of miles had similarly been authorised and constructed when the first railway to be built for use by the public generally was opened from the Thames at Wandsworth to Croydon, with a branch to Carshalton, in 1801. Over twenty years before the Stockton and Darlington was sanctioned, the question of laying railways along the high roads, upon which, on payment of tolls, wagons, post chaises and private carriages could run, was being publicly discussed. The evolution of the Stockton and Darlington, even to the running thereon of passenger-carrying vehicles, was thus almost natural. What, however, was hardly anticipated, and as a consequence became the most original part of the scheme, was the employment of locomotive engines. Therein, and not in the laying of rails nor in the running of passenger-carrying vehicles, lay the foundation of the benefits of railway communication. And, anticipating some remarks further on, we would say here that if such be the case, we are, in fact, about to celebrate next year a minor and not the major event. It is now too late to commemorate the hundredth anniversary of what Trevithick, Stephenson, Hedley, Blenkinsop and others did in the closing years of the eighteenth and opening years of the nineteenth century. The labours of these men who built and ran locomotives before the Stockton and Darlington was thought of, and the story of the subsequent development of the locomotive will be dealt with in our columns in a series of articles entrusted to the capable hands of Mr. E. L. Ahrons. The general series, which begins in the present issue, will show the gradual growth of the railway system of the United Kingdom; the piecemeal concentration of the main members into twenty or so large companies and the absorption in 1922 of the one hundred and nineteen British companies, that were not either wholly in the London area, jointly owned or light railways, into four large concerns. We hope to show the attitude of Parliament towards railways and the extent to which they have been subject to Government control. It is gratifying to be able to state, in this connection, that rarely have there been any dishonest dealings or tainted finance in the promotion of the railways of this country. We intend, in addition to Mr. Ahrons' treatment of the development of the locomotive, to show how the carriages, wagons, track, stations, &c., of to-day have reached their present high standards. In no country in the world has more attention been paid to detail or more care been expended on construction. Such thoroughness has meant great expenditure, and, in part, accounts for the comparatively high cost per mile of our railways. But that the expense has been justified is shown by the freedom from accidents which are attributable to failures of track or equipment. Particularly was our pre-eminence in this respect remarkably manifest in the way in which road and rolling stock stood the strain of the trying years of the war—a period during which the systems of all other belligerent countries, even the United States, collapsed. Signalling, the block system and continuous brakes will be noted as being important factors in what is perhaps the outstanding feature of British railways—their high degree of freedom from accident. This condition would, however, have been altogether different had not these safeguards been in the hands of men whose steadfastness, whose appreciation of rule and regulation, and whose readiness to rise to an occasion are remarkable. The men at the head of affairs who designed, built, organised and administered our railway system will also be alluded to. Finally, we hope to cover the relations between the railways and the public and between the companies and their men. That these have, on the whole, been satisfactory

may be judged by the fact that no Government has yet encouraged the State purchase of railways. Moreover, many previous supporters of nationalisation now hold different opinions thereon as a consequence of the control by the Government during the war. We cannot close our eyes to the fact that the opening of the Stockton and Darlington was not the greatest of the railway events of that period. It was not the first railway to be sanctioned nor the first public railway; neither was it the first to be authorised to carry passengers, nor that did carry them. It was, moreover, not the first railway on which locomotives regularly ran. Yet, looked at as a whole, it was unquestionably the first undertaking which could be regarded as a public railway, and for a hundred years it has been universally, and quite rightly, regarded as the *doyen* of the railway system of the world. It is fitting therefore that its centenary should occupy our attention. The opening of the Liverpool and Manchester Railway five years later was an event of greater importance. Powers to make it were obtained in the face of great local and parliamentary opposition—and ignorance. In many respects, the difficulties associated with its construction were unparalleled. Unlike the Stockton and Darlington, the conveyance of passengers was deliberately sought and catered for from the first. In this country the celebrations will begin with the holding of the tenth session of the International Railway Congress. Following that will come the opening, on July 3rd, of an exhibition of railway relics at Darlington. The local authorities of that town and of Stockton-on-Tees and Yarm are co-operating, and it is to be hoped that the cities of Liverpool and Manchester will take a part. Both cities had business men engaged in promoting and developing railways in all parts of the country, and the events next year would be a suitable opportunity to testify to the good work done by them by their faith in the Liverpool and Manchester and other railway schemes.

In this utilitarian age it may be thought remarkable that so much attention should be devoted to a centenary, and people are not wanting who ask what value resides in such things and in the history of the great events of technology upon which our industrial position is founded. To that question no definite answer can be given, if by value is meant a return in pounds, shillings and pence. If, however, we look upon such subjects from what is perhaps the higher aspect, that they do something to cultivate the mind and to enlarge the understanding, there is a great deal to be said for them. It is, indeed, difficult to understand why the world has consistently regarded the history of wars and politics as a necessary element of education, and yet has neglected the history of those industrial events which have made far more difference to it than the ambition of kings and the chicanery of courtiers. Amongst such events, the coming of railways holds a position of incomparable importance, and to trace their rise and development and the progress of the design of vehicles and of the engines which haul them is something for which we may justly claim that it is not only of interest, but that a knowledge of it may do as much towards the making of cultivated men and women as the details of the Norman Conquest or the names of the battles in the Civil War. A nation does not live by its conquests, by its political machinery or by its laws. It lives by its industry and its invention, and the history of such things merits more attention than it has hitherto received.

The Limitation of Naval Strength.

To effect a reduction in the world's armaments by mutual agreement among the nations concerned was, until recently, an idea cherished only by ardent souls who gave little thought to the practical side of international politics. The Washington Conference of 1921–22 proved, however, that the scheme was feasible enough in special, and very favourable, circumstances. Encouraged by the large measure of success which attended the negotiations at Washington, certain people in this country and the United States are urging that a further step be taken in the direction of armament limitation by summoning a second Conference to amplify, if not to complete, the work of the first. Proposals to this end have been made more than once in the present Parliament. The Government, judging by the Prime Minister's words, sympathises in principle, but doubts whether the time is ripe for a definite move. It would prefer to see the German reparations tangle unravelled and other pressing problems in Europe brought within sight of solution before it engages in pourparlers with other States on the subject of retrenchment in combatant forces. There is no denying the wisdom of this cautious attitude. Armaments being merely the handmaid of policy, it is obviously futile to seek their reduction on an international basis unless and until the major differences outstanding between the various Powers have been composed, or at least brought within measurable distance of accommodation. We in Europe are perhaps in a better position than our American friends to observe the intimate connection between military preparedness and national policies. A rapid survey of the present situation suffices to show that those countries, great and small, which are menaced, or believe themselves to be menaced, by jealous rivals are maintaining military establishments out of proportion to normal requirements. Poland and Roumania are cases in point. France, too, considers a great army and a very powerful air force to be essential to her security. It is useless to urge these Powers to cut down their armaments unless we can first persuade them that their safety or their vital interests would not be prejudiced thereby. In other words, it is the disease that calls for treatment, not the symptoms to which it naturally and inevitably gives rise.

When approving the current budget for the United States Navy, both Houses of Congress sanctioned a resolution inviting the President to take measures for the calling of a second Conference for the restriction of navies. If Mr. Coolidge has not yet taken action in this matter, it is because he realises no less clearly than our Prime Minister the futility, not to say the danger, of placing the cart before the horse. The five leading naval Powers have already agreed to restrict their fleets by a given formula of relative strength in regard to battleships and aircraft carriers, and since the battleship remains, by almost universal consent, the key factor in every estimate of naval strength, the elimination of competitive building in this type is a great boon to mankind. It is now said that certain of the Treaty Powers, Japan prominent among them, are devoting to the multiplication of cruisers, submarines, and other minor craft much of the energy they formerly expended on Dreadnought construction. That Japan has laid down or ordered a considerable number of these vessels since the Washington Conference is made evident by her own official figures. France has also embarked on a comparatively large programme of so-called "auxiliary" construction within the same period. Hitherto there has been no corresponding activity in the United States or this country, and, in consequence, the balance of naval strength which the Treaty sought to establish is already in jeopardy. So far as the British Navy is concerned, that balance will be restored, in part, by the shipbuilding programme authorised last March, and about to be put in hand, under which five cruisers and two destroyers will eventually reinforce the Fleet. A larger programme—consisting of eight cruisers and six gunboats—was adopted by the American Congress some weeks ago, but opponents of the Bill have contrived to delay its execution until next year. The result is that the United States Navy is very ill-provided with the ancillary types—*e.g.*, fast cruisers and ocean-going submarines—which promise to assume an entirely new importance now that the heavier ships are so drastically limited in numbers. To remedy this shortage and restore American parity in tonnage would require a very large expenditure of money, which the American public, we gather, is anxious to avoid. The only alternative is to induce the other Powers to curtail their "auxiliary" programmes, which, if carried out, would leave the American Navy still further in the rear with respect to cruiser and submarine tonnage. It is evident, therefore, that if such limitation could be accomplished through the medium of diplomacy, the United States would stand to gain more than any other party. That, of course, is no reason why the attempt should not be made if the prospects of success were sufficiently bright. But when the conditions antecedent to the first Conference are compared with those prevailing now, we think it will be admitted that the atmosphere essential to the smooth negotiation of a fresh treaty of disarmament has yet to be created. In Europe we find France hard at work on a shipbuilding project designed to restore the French Navy to the position it occupied ten years ago. Since French naval opinion discounts the value of the capital ship, the new programme is devoted to light cruisers, surface torpedo craft and submarines. Concurrently, the naval aviation service is to be expanded. Remembering how stoutly the French delegates to the Washington Conference held out for a large allowance of submarine and other "auxiliary" tonnage—at which time practically no vessels of this description were on the stocks in that country—it is at least doubtful whether France would lend a willing ear to-day to proposals that aimed at cancelling most, if not all, of the ships she is actually constructing. Yet unless France agreed to make a substantial reduction in the submarine programme on which she has already embarked, no British Government could consent to restrict its output of anti-submarine types, among which the light cruiser occupies an important place. Here, then, would be the threat of a deadlock at the very outset. Turning to Japan, we find that the British Admiralty return, published in March, credits the Far Eastern Empire with the following men-of-war, building and projected, at that date:—Twelve light cruisers, twenty-eight destroyers, and thirty-three submarines. Now the Japanese authorities have stated repeatedly that this amount of new construction is the minimum with which they can be satisfied. Moreover—and this is important to note—it was authorised two years ago, well in advance of the British and American post-Conference programmes. Apart from the requirements of national defence, it was framed with an eye to the welfare of the shipbuilding industry, which has been very short of work since the Washington Treaty put an end to battleship construction. In these circumstances, it would seem expedient, before arranging a new Conference, to sound Japan as to her readiness to forego, either wholly or in part, the reinforcements she has in view for her fleet. Finally, there is the question of Great Britain's right to a specially high allotment of cruiser tonnage on the ground of her dependence on seaborne trade and the consequent necessity of affording it adequate protection. From unofficial statements by American critics, it would appear that the United States is unwilling to concede the British Navy a ratio of cruiser strength higher than its own, and would insist, as in the case of the battle fleets, on absolute equality.

These are but a few of the practical difficulties that must be surmounted before the path lies clear for an extension of naval limitation. To summon a new Conference before the views and intentions of the Powers interested were known with some degree of certainty would be to court a fiasco, the effect of which on international relations might be very harmful. For this reason the disarmament enthusiasts who are calling loudly for such a Conference are doing a real disservice to the cause they have at heart. The apparently complete failure of the Naval Conference held at Rome early in the year, under the auspices of the League of Nations, should be a warning against hasty and ill-considered action in this particular sphere of world politics.

Obituary.

WILLIAM ALFRED PEARN.

THE death occurred very suddenly on the 26th ult. of Mr. William Alfred Pearn, partner in the firm of Frank Pearn and Co., Limited, Manchester. Mr. Pearn was sixty-six years of age and was the youngest of the three brothers, Sinclair, Frank, and William, who built up a business which has a high reputation in the engineering world. Mr. Frank Pearn, the head of the concern, died a few years ago. Although Mr. William Pearn took a very active part in the business with which he had been intimately associated since boyhood, he was little known in public life. He devoted his attention almost entirely to works management and was responsible for several useful inventions, notably the lightning tapper and the horizontal surfacing, boring, drilling, and tapping machine. The lightning tapper is almost too well known to need mention. It comprises a clutch device which is held together by an adjustable helical spring sufficiently tightly to drive the tap home, but which is sufficiently flexible to slip when the tap has touched the bottom of the hole, so that breakage of the tap is prevented. The horizontal boring and facing machine was originally designed by Mr. Pearn for facing pipe flanges in connection with the firm's pump work, but the machine proved so remarkably adaptable that it has subsequently been developed to perform quite a number of operations, making its field of utility very wide. In fact, there are few machine tools in existence which can claim to deal with such a remarkable range of work. To Mr. Sinclair Pearn, the eldest of the three brothers, who is still actively engaged in the management of the business, we tender our sympathy in the great loss which he has sustained.

One Hundred Years of British Railways.

No. I.

THE STOCKTON AND DARLINGTON RAILWAY AND ITS PREDECESSORS.

THE ORIGIN OF RAILWAYS.

THE event of which September 27th, 1925, will be the hundredth anniversary was not the opening of the first public railway, but the opening of the first public passenger-carrying railway. There is significance in that word "opening." The Stockton and Darlington—the railway in question—was not, as is generally supposed, the first railway *authorised* to convey passengers. That honour lies with the Berwick and Kelso Railway, sanctioned by 51 Geo. III., c. 133, on May 31st, 1811, but never constructed. Sec. 1 of the Act just named recited that its purpose was to make, complete and maintain a railway or tram-road—the hyphen was used in the latter, but not in the former word—for the passage of wagons and other carriages. Sec. 55 sanctioned a charge not exceeding 2d. per ton per mile for every carriage conveying passengers. No other Act had similar charging powers until the Stockton and Darlington Railway Company obtained them, and that, like the use of locomotive power, was an afterthought. Three railways of the pre-Stockton and Darlington period—Oystermouth (1804), Kilmarnock and Troon (1808), and Stratford and Moreton (1821)—conveyed passengers, but without any specific powers. The secretary to the Kilmarnock and Troon told the Select Committee of 1839 on Railways that his company had no power to convey passengers or to levy a duty on individual passengers, but that there were a few carriages for the conveyance of passengers. The Stratford and Moreton Company, on the same occasion, reported that some of the wagoners had a licence from the company to carry passengers. For that privilege it paid £1 per month. It was believed that it received about 1d. per mile per passenger.

The Stockton and Darlington Act—1 and 2 Geo. IV., c. 44—was not obtained until ten years after the Berwick and Kelso—being passed on April 19th, 1821—and not until two years later still were powers obtained to carry passengers. The Kelso Railway was, as we have said, never proceeded with, and the powers lapsed. The line that runs to-day between Berwick and Kelso was opened in 1846, and does not follow the route sanctioned by the Act of 1811. The latter proposed to cross the Tweed near Twizell, east of Coldstream, and so enter Scotland and re-enter England at the county boundary. The bridge that was to carry the railway over the Tweed at Twizell was to be open, on payment of a toll, to vehicular and foot traffic. The present railway is to the south of the Tweed throughout.

The main reason for celebrating the opening of the Stockton and Darlington is because it was the first railway to obtain powers to work its trains by locomotives. That method of hauling trains was not, however, provided for in the original Act, but by 4 Geo. IV., c. 33, of 1823, which allowed the company to "make and erect . . . loco-motive or moveable engines . . . and to use and employ the same in and upon the said railways or tramroads. . . ."

Actually, the first public railway was the Surrey Iron Railway—quoting the name given in the Act. It was sanctioned by 41 Geo. III., c. 33, which received the Royal Assent on May 31st, 1801, and gave powers for the construction of a railway "from or from near a place called Ram Field in the parish of Wandsworth to or near a place called Pitlake Meadow in the town of Croydon," and of a branch from the said railway "from or near Mitcham Common to or near to a place called Hack Bridge in the parish of Carshalton."

Between the Act for the Surrey Iron Railway and that sanctioning the Stockton and Darlington, twenty-one other railways were authorised. Powers to make railways, railroads or tramroads—at that time spelt with a hyphen—had frequently been granted prior to those sanctioned during the 1801–1821 period. They were, with one exception, all granted to canal companies. The exception was a wagon-way authorised on June 9th, 1758, by 31 Geo. II., c. 22, "in order for the better supplying the town and neighbourhood of Leeds in the county of York with coals." This wagon-way ran from the collieries at Middleton—where Blenkinsop tried his locomotive—to staiths near what is now Meadow-lane in the city of Leeds.

In South Wales and in the Midlands these lines for giving communication between mines, quarries, lime kilns and canals were known as tramroads, but in the North of England they were originally called wagon ways, *i.e.*, ways or paths for the coal wagons to pass along. All readers of early history will remember what Roger North said about his brother going on circuit to Newcastle about the year 1676. According to that writer's "Life of the Right Honourable Francis North, Baron of Guilford, Lord Keeper of the Great Seal under King Charles II. and King James II." (1742):—"Some of the aldermen related strange stories of their coal works. One related to wayleaves: When men have pieces of ground between the colliery and the river they sell leave to lead coals over their ground and so dear that the owner of a rood of ground will expect £20 per annum for this leave. The manner of the carriage is by laying rails of timber from the colliery down to the river, exactly straight and parallel, and bulky carts are made with four rowlets (rollers) fitting these rails whereby the carriage is so easy that one horse will draw down four or five chaldron of coals and is an immense benefit to the coal merchants."

There is, however, a yet earlier record of wagon-ways. One Peter Delaval, a London merchant, and one Ambrose Dudley obtained in 1595, a lease from the Crown of the whole of its mines in the coalfields of Cowpen and Bebside, *i.e.*, near to Bedlington. Delavel was unfortunate and failed. In 1602 the lease was assigned to a party of gentlemen from Nottinghamshire and Leicestershire, amongst whom was one Huntingdon Beaumont, of Bilborough, near Nottingham, the younger son of Nicholas Beaumont, of Coleorton, Leicestershire. William Gray, in his Chorographia (1649) spoke of Beaumont having brought with him "many rare engines, not known then in these parts; as the art to boore with iron rodds to try the deepnesse and thicknesse of the cole; rare engines to draw water out of the pits; waggons with one horse to carry down coles from the pits to the staithes to the river, &c."

The quotation just given, as to wagons, with one horse, to carry coals from the pit to the river, implies a wagon-way, and suggests that such was introduced by Beaumont in or about the year 1602. That gentleman came from Bilborough, which is situated on the north-west side of the city of Nottingham, and near to Wollaton Hall. The MSS. preserved by Lord Middleton at the latter place were recorded by the Historical Manuscripts Commission in 1911, and therein are references to Huntingdon Beaumont, but of dates subsequent to 1602. It is important to note, though, that Beaumont was described, when he went to Cowpen and Bebside in that year, as "of Bilborough." Among the MSS. is an account reproduced as follows:—

"1598 (wrongly written 1698) Statement of the charge receipt and delivery of coals at Wollaton week by week from October (1597) to October (1598). The whole gettes this year 13264 rookes 1 quarter. The whole sale and deliverie to all persons, railes and bridges 13271 rookes 2 quarters. Particular receipts of money from Gainsborow £1.3s., from Newark £135.19s., from the Bridges £38.13s.3d. The totall charge is £2977.6s.1d. The totall receipt is £2696.1s.6d."

The documents of later dates than 1602—generally about 1610—also speak of "railes," so that it is reasonable to assume that there was a wagon way from the pits at Wollaton and Strelley on the Wollaton estate to the river Trent, to carry coals for shipment to the Trent Bridges, Newark and Gainsborough. It is evident, too, from the account of 1598 that the wagon-way was there in 1597.

The only other authoritative references, other than those in the Middleton MSS. to Huntingdon Beaumont, are contained in the History of Northumberland, Vol. IX. (1909), where it is noted as a curious fact that, beyond the mention in Gray's Chorographia, there is no record of the doings of Beaumont. That his appearance must have taken place early in the seventeenth century, or sooner, seemed to be proved by the fact that the art of boring was known in Northumberland as early as 1615. At that date it did not appear to have been very generally practised, mention being made in a letter—reproduced in the Duke of Northumberland's MSS.—by the Earl of Northumberland's agent at Tynemouth of the difficulty he experienced in obtaining a borer, the only available one being in the employ of his competitors at Newcastle.

It is thought that Huntingdon Beaumont's rare engines practically all originated from Germany. He may have visited that country in his early days—there is no record that he did so—and if he studied German mining methods he would come across the mining tram and truck. There are several authentic records of trams and trucks being used in Bohemia and the Tyrol.

The literature of the subject shows that not only were tramroads and trucks used in Germany before they were introduced into England, but that the use of strips of iron on the wooden rails was also anticipated. These strips were called "Reibeisen," and were nailed down on the rails at curves where there was much wear. Friese remarked on this point, "It cannot but be held that in these Reibeisen we must recognise the first beginnings of railways, although they seem to have been used only to protect the rail and only at curved stretches." The use of rails and trucks was also known about that time in Italy.

There is a possibility that the idea of trams and trucks was brought to this country by the German "adventurers" who were mining for copper at Keswick in 1565 and 1566. Copper smelting works were erected in those years on the banks of the river Greta, on the north-eastern side of the town of Keswick. The mines were in the Vale of Newlands, and the copper was conveyed to the western shore of Lake Derwentwater and shipped thence to Keswick. All this was done by a colony of Germans, as related in "Mines and Mining in the (English) Lake District" by Mr. John Postlethwaite (W. H. Moss, Whitehaven, 1913). It will not be without interest to hear that Mr. Postlethwaite was the accountant to the Cockermouth, Keswick and Penrith Railway until his retirement ten years ago. The mines at Keswick were on land granted to the Percy family and, through the Percy interest, the use of trams and trucks might thus become known in Northumberland where the Percy family resided.

Except the doubtful case mentioned above, of the "railes" from Wollaton to the Trent, it seems certain that the first wagon-way was that put down by Huntingdon Beaumont at Bebside in Northumberland. The position of that place is clear, as there is a station of the name on the London and North-Eastern Railway between Newcastle and Morpeth *viâ* Newsham. It is about two miles east of the town of Blyth. Cowpen lies between Bebside and Blyth but nearer the former. The river Blyth runs about half a mile to the north of Bebside, and it was to that waterway that the wagon way was led. The late Mr. W. W. Tomlinson, in his "The North-Eastern Railway: Its Rise and Development" (1914)—a work to which the present writer and all writers on railway history will ever be greatly indebted—said that Beaumont's example was quickly followed.

Experience showed that the timber rails became worn by the action of the wheels, and that the continual replacement of and additions to the "pegs of wood" that fastened them down, weakened the rails. They, consequently, frequently broke and their upkeep became costly. This experience led to the introduction of a second rail, superimposed on the first, which had the advantage that it could be worn deeper without imperilling the bearing power of the track. The first use of iron as the upper rail of the "double-way" came about, under unusual circumstances, in the year 1767. The price of pig iron at that time was very low, and William Reynolds, of Ketley, one of the partners in the Coalbrookdale ironworks, ordered, in order to keep the furnaces alight, some pigs, 5ft. long, 4in. broad, and 1¼in. thick, to be made. Five or 6 tons of these rails were cast on November 13th, 1767 (Robert Stevenson in "Transactions" of the Highland Society of Scotland, Vol. VI., 1824), and were laid in the Coalbrookdale works as a substitute for the upper wooden rail. Mr. Rhys Jenkins, in his paper "A Sketch of the Industrial History of the Coalbrookdale District," read before the Newcomen Society on the 19th ultimo—page 694 of THE ENGINEER, June 20th, 1924—said that there were two stories as to the date of this use of cast iron rails. One was that it was between 1750 and 1763, and the other story gave the period as 1763–1768. The latter version added that the work was done by Richard Reynolds and not, as Stevenson said, by his son, William Reynolds. Mr. Jenkins said that Mr. W. G. Norris, the manager of the Coalbrookdale concerns from 1867 to 1897 and their historian, made it clear that iron rails were laid down between Ketley, Horsehay, and Coalbrookdale, and that, in the years 1768–1771, 800 tons of cast iron rails were produced. Robert Stevenson's remarks quoted above were made after a visit to Coalbrookdale, and the details as to the cast on November 13th, 1767, were taken from the company's books. Anyway, to Coalbrookdale, therefore, we owe the first iron railway, as also the first cast iron bridge. In 1785 the wooden wagon-way at Alloa, laid down in 1768, being worn out and requiring renewal, was, according to "The Statistical Account of Scotland," Vol. VIII. (1793) renewed "on a new plan, and it is now acknowledged to be the most complete in Britain." It was a double-way and the "new plan" was the use—for the first time—of a bar of malleable iron 1¾in. in breadth and ¾in. thick laid on the top of the upper rail.

SWISS RAILWAY ELECTRIFICATION.—In connection with the articles on the Swiss Federal Railways, published in our issue of June 6th, 13th, and 20th, we are requested to state that all the electric locomotives now being built for the Federal Railways as far as the mechanical portions are concerned, were entirely designed by the Swiss Locomotive Machine Works at Winterthur, and that the mechanical parts of all of them were built by this firm. We may add that as a result of the successful operation of these locomotives the Swiss Federal Railways have entrusted this firm with the orders for all the mechanical parts of their electric locomotives.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—On Saturday, June 28th, the members of the Manchester Geological and Mining Society and their friends, had an excursion to the Edale-Castleton district, under the guidance of Professor Owen T. Jones, of the University, Manchester. The party proceeded from Edale Station by way of Barber Booth and Mam Nick to Windy Knoll. On the way Professor Jones explained the succession and structure of the carboniferous shales and sandstones which occur between the limestone and the Kinder Scout grit of the Peak District, and pointed out that these rocks previously thought to be equivalent to the Yoredale series, had recently been shown by various workers to be above that series, and the Yoredale series is either absent in the district or is represented by the limestone of Derbyshire. At Windy Knoll the party was met by Professor Sir William Boyd Dawkins, who delivered a very interesting address on the Pre-historic Features of Mam Tor and Windy Knoll, referring more particularly to the large numbers of bones of bisons, bears, wolves, reindeer and other animals which had been found in an old swallet hole, near the present quarry. He also called attention to the elaterite and bitumen, which represent the residue of a former deposit of petroleum, pointing out that the petroleum found at great expense to the Government by American engineers near Chesterfield, occurred as at Windy Knoll, at the junction of the shales and the limestone and that the expensive borings proved no more as regards the rocks than could have been seen at the surface. From Windy Knoll the party proceeded by the Winnatts to examine an old volcanic vent near the Speedwell Mine and then to the Peak Cavern.

Institution of Naval Architects.

JOINT SUMMER MEETING.

No. II.*

IN our last issue we dealt with Sir John Biles' paper on "Ship Design," and a paper by Mr. S. S. Staples and Captain D. J. Munro on "Advanced Naval Bases." The next paper taken on the morning of Wednesday, June 25th, was by Mr. G. S. Baker, and was concerned with problems arising in connection with "Steering of Ships in Shallow Waters and Canals." It was accompanied by appendices by Miss E. M. Keary and Mr. G. H. Bottomley.

STEERING SHIPS IN SHALLOW WATER.

This paper gives an account of research work on a number of ships and models in shallow water. Some of the work, including that in the Suez Canal, has been carried out as part of the investigation on the steering of ships approved by the Advisory Tank Committee, while the majority of the model tests have been made under instructions from several different firms.

The conditions which exist around a ship moving in shallow water differ considerably from those in deep water in two important respects.

(1) The flow around the ship is no longer truly three-dimensional.

(2) The sea room is restricted and more accurate steering is necessary.

The change from three to two-dimensional flow increases all the pressure and velocity changes in the water. This has its most important effect in the after body. The streams have to close around the stern in more or less horizontal planes, and therefore with greater curvature than when the flow is three-dimensional, and this more rapid closing in of the streams has to be accomplished with much greater rate of change of pressure than before. It is well known that stream lines in open water will not expand beyond a certain rate, nor can they deliver up energy beyond a certain amount. Breakdown in flow is therefore more likely to occur in shoal water. This, in fact, can be seen in the great increase in eddy formation at the stern of any model or ship when moving from deep to shallow water. These greater pressure changes and additional eddy formations cause an increase in resistance to propulsion, an increase which becomes more pronounced the more restricted the channel. A second effect of these pressure changes is the increase in virtual mass represented by the ship and its streamline system. Underneath the ship the water gap between the hull bottom and the sea bottom is restricted, and the difficulty of maintaining steady streamline flow at this part is aggravated by the frictional drag of the hull. The conditions which will develop unsteady flow under the ship are not defined in this paper, but it is clear that any spasmodic variation of flow is liable to render the ship directionally unstable, particularly if this occurs in the fore body. When the ship is in a dredged channel or canal the flow of water past the ship will be different on the two sides, unless it is able to keep to the centre of the waterway. It has also been demonstrated that any variation in depth of channel on the two sides will cause an important effect on the character of the flow and result in unequal pressures on the two sides of the hull. These differences in pressure on the two sides of the ship exert a moment tending to make the ship yaw. This moment will increase as the ship approaches any bank or as the water shoals on one side of her more than on the other—the tendency being, in all ships so far tried, to make the ship sheer off the bank or out into deep water. Whatever the steering value of the rudder may be in shoal water, therefore, it has to deal with a larger virtual mass than in deep water, and contend with considerable yawing moments not experienced in deep water.

An examination of the results given in the paper and the appendices shows that :—

(1) In shoal water the time taken by the ship to turn a given small angle off its course is longer than in deep water, and this delay is largely due to the longer time taken to start the yaw.

(2) The side banks of a canal increase this unsteadiness, not because of the restriction of flow arising from the small cross section of canal, but because of the large yawing moments produced by the ship getting near one of the banks.

(3) Unsteady steering begins to show itself when the draught exceeds 0.7 times the depth of water, but any attempt to go at high speeds will also produce it.

(4) The limiting good speed in the Suez Canal for ships tested with reasonably effective rudders is about 7 knots for draughts of 23ft. or less, and 6.5 knots for 26ft. draught. With a following tide or an ineffective rudder a lower speed must be adopted.

(5) In twin-screw ships the rudder should swing into the screw race at a fairly small angle. Ships in which this angle is over 15 deg. have not good reputations in the Canal, but a smaller angle than this is desirable.

(6) If the ship through being near a bank develops a bad sheer across the Canal, and the helm appears to be insufficient to stop it, the better manœuvre is to stop the engine on the bank side, rather than to go full ahead on the other engine. It is wrong to go astern on the engine on the bank side.

(7) That some trustworthy means should be provided on the bridge to indicate (*a*) the exact position of the helm at any instant, and (*b*) the rate and direction of revolution of the engines. The paper is accompanied by tables, curves, and illustrations of the rudder arrangements. In two appendices by Miss E. M. Keary and Mr. Gordon Bottomley details of the steering experiments made on various models are given.

Mr. S. W. Barnaby said that he was familiar with one of the ships referred to in the paper, and he knew the result of the experiment was to show how closely the work of the tank predicted actual results. Lloyd's Register acted wisely in dealing with the strength of rudders. The very large increase in the rudder would naturally have called for an increase in the stock, but it was recognised that the stock had been designed for pressures which never came upon it in the ordinary way.

Sir John Biles referred to a case which came under his own notice of a vessel which had been navigated in the Hooghly and the Thames by an experienced captain, who declared he would not go to sea in the ship again, as he could not steer her in shallow waters. The problem was taken up by Mr. Baker, who reproduced in the tank the conditions existing in the Hooghly and the Thames, and a new rudder was ultimately fitted which did away with the difficulty previously experienced. The type of rudder proposed by the captain to remedy the evil would not have been of any use. What had happened in this case was a complete justification of model experiments.

Sir Thomas Fisher (Canadian Pacific Railway) said that some of the work had been carried out in connection with Canadian Pacific vessels, which were the largest vessels capable of using the St. Lawrence River. An accident happened to one of their ships in that river, the vessel taking an unexpected sheer, which was attributed either to failure on the part of the helmsman or the steering gear. There was an inquiry into the accident, but the evidence was by no means conclusive. Mr. Baker was therefore asked to reproduce the conditions in the Teddington tank and carry out some experiments. The work was extended to cover the passing of two ships in narrow channels, and these later experiments were the subject of observations made when their ships were making the passage of the river Clyde. The information derived from tank work was borne out in practice, and gave confidence that tank experiments would indicate in a general way what would happen under given conditions. He agreed with those who laid stress on the need of full-scale work being carried out, but would point out that ships' officers had great difficulty in finding time to assist.

Mr. Baker, in replying to the discussion, referred to the importance of full-scale work, and expressed his gratitude to officers with whom he had been associated in this connection who had spent a great many hours in doing things the exact purport of which they did not always understand.

A paper was presented by Mr. John Anderson, of which he and Mr. Robert Steele were joint authors, discussing "Passenger Ship Design from an Independent Point of View."

AN INDEPENDENT PASSENGER SHIP DESIGN.

The remarks in this paper are directed principally towards the intermediate speed class of vessels designed primarily for passenger service across the Atlantic, but it is also thought that the views expressed might be applicable to liners on the Australian and Pacific runs, considering that it is desirable to reduce the number of fueling stations to a minimum.

The post-war era has clearly demonstrated the popularity of the intermediate type of liner, which is shown by the tonnage of that class in service to-day.

Present-day ships are designed to carry passengers from a deck which is well below the designed load line to the top of their high superstructures, although in many cases the lower 'tween deck accommodation has been arranged to be portable in order that cargo may be carried in the spaces during the off-passenger seasons.

This class of ship appears to have been heavily hit by the American Emigration Laws, catering, as it does, for that emigrant traffic which is the foundation of the Transatlantic passenger trade, and which should yield a large proportion of the annual revenue ; but, owing to the restriction in the numbers of emigrants allowed into the States, other employment has to be found periodically for such ships, and we find them being sent on world cruises, presumably with their cargo space empty except for those parts which may be utilised for extra stores. Before the advent of oil fuel a considerable amount of cargo space was taken up by reserve bunkers, but since coal has been superseded by oil this space can be utilised for cargo or stores. It is doubtful, however, whether such ships can generally load down to their designed draughts with the classes of cargo obtainable in relation to the space which is available, and it would appear under modern conditions to be customary to obtain a little cargo in one direction and only part capacity cargoes in the other.

One of the authors has already stated his opinion that the enforced disposition of cargo in conjunction with the superstructures now in vogue does not give a proper balance in stability between the light and load conditions, and it might also be said that any design which makes provision for carrying cargo affects the trim and the most suitable position of the centre of buoyancy from the point of view of economical propulsion.

It is sometimes found that when these ships are designed to obtain even keel in the loaded condition with cargo, the trim is as much as 10ft. by the stern when light, which is very undesirable from the point of view of docking, since it involves the use of considerable quantities of water ballast, thereby increasing the mean draught.

The matter of arranging hatchways, winches, derricks, &c., to work the cargo in such vessels has been complicated in recent years on account of the problem of arranging boats and life-saving appliances for all, under the new regulations, and also of placing water-tight bulkheads so that the best system of subdivision is obtainable. There is no doubt also that the hatchways and other cargo equipment have increased the difficulty of arranging entrances, berthing, &c., for the passengers accommodated on the lower decks, also that serious loss of time is involved in the lifting and lowering of cargo from the holds to the tops of the trunk-ways, tending to increase the time required to "turn round," and so decrease the number of voyages per annum.

These difficulties caused the authors to consider whether or not conditions had now reached such a stage of development as to make cargo carrying unprofitable in this class of vessel, and, if such were the case, to determine the best lines to work along in order to design a more economical ship to suit present-day requirements.

In the initial investigations it was assumed that the machinery would be double-reduction geared turbines, which is the type of machinery generally installed in present-day vessels of this class. The results, although seeming to show a considerable improvement over the type ship, did not indicate economies to the extent which we expected. On substituting oil engines for geared turbines the results were considerably improved. It may be stated that in estimating the relative initial values of the two ships a very liberal allowance was made for the high cost per horse-power of internal combustion engines.

The results of the investigations are indicated in three tables,† and they show a comparison between the proposed ship and a typical ship recently built which is representative of the class generally employed on the Transatlantic service to-day. Some particulars of the two ships are given in a table in the next column.

It will be seen that, compared with the "Type" ship, it is proposed to reduce the depth by 7ft. 9in., and this in conjunction with a reduced breadth of 1ft. 3in. and a much finer model, which results from a number of considerations, permits of a considerable reduction in weight of hull, while the tonnage measurement will be greatly reduced. It would also be permissible to dispense with the orlop deck forward on account of the reduced depth ; the freeboard will be precisely the same in both ships.

Furthermore, the lighter vessel, reduced fuel, lower power, and absence of cargo permit of designing the vessel with a block coefficient of 0.54 on a draught of 20ft. 8in., and the reduced block coefficient and displacement enable the speed to be obtained with only 55 per cent. of the power required for the "Type" ship. The space required for machinery in the "Type" ship can be reduced in the proposed ship by about 50ft. in length by fitting oil engines. With the absence of hatchways, except that to the baggage hold, and by making the total length of super-erections the same in both vessels, it is found possible to carry at least the same complement of passengers as in the "Type" ship, even allowing for the finer lower decks of the resulting model, while the airing space on deck will be increased.

It might be explained that the form which we have under consideration has been specially prepared to give exceptionally full body above water, in order that the fine form will not be objectionable for Atlantic weather conditions.

With the finer model and with the displacement and the draught considerably reduced, it was found possible to reduce the shaft horse-power required to give the proposed service speed of 16 knots from 12,500—being that of the "Type" ship—to 6900, which brought the power well within that range which builders of Diesel engines were prepared to construct, and the reduced power helped to bring down the initial cost of the machinery in comparing the two ships. One of the most important economies effected is that in fuel. The oil engines would consume approximately 40 per cent. of the fuel per horse-power required for an oil fuel geared turbine installation.

Comparative Particulars of Proposed and "Type" Vessels.

Item.	Proposed vessel.	"Type" vessel.
Length	550ft.	550ft.
Breadth	68ft. 9in.	70ft.
Moulded depth	35ft. 9in.	42ft. 9in.
Load draught	20ft. 8in.	28ft. 10in.
Weight of vessel, tons	10,200	12,560
Fuel for 20 days, tons	590	2810
Fresh water for 10 days, tons	600	1300
Stores for 10 days, tons	250	250
Passengers and baggage, tons	350	350
Cargo, tons	Nil	5960
Load displacement, tons	12,050	23,230
Block coefficient	0.54	0.73
Service speed, knots	16	16
Shaft horse-power	6900	12,500
Type of machinery	Diesel	D.R. geared turbines
Initial cost (approx.)	£526,000	£560,000
Gross register tonnage	11,800	16,365
Net register tonnage	7300	9877
Number of first-class passengers	235	235
Number of second-class passengers	355	355
Number of third-class passengers	1256	1256
Crew	344	360

The estimated annual savings which the proposed vessel might offer compared with the "Type" ship are calculated on the basis of eleven round voyages per annum, and it is assumed that the Diesel fuel oil would cost 20 per cent. more than ordinary boiler oil.

These estimated annual savings, which total £91,000, make it necessary, in order that the "Type" ship may prove as economical a proposition, that she must secure full cargoes both ways at a net freight rate of about 14s., exclusive of the cost of handling, management, &c., which might amount to an additional 6s. per ton. This is the most optimistic view which can be put forward for the "Type" ship, but it is very doubtful if full deadweight cargoes could always be stowed in such a ship, assuming it were possible to obtain them. Under present-day conditions it seems more probable that the ship's maximum lift with a full complement of passengers would be not more than 3000 tons in one direction, and generally little or none in the other ; such loads would necessitate a net freight rate of about 48s., and it is improbable that such an average rate could be obtained.

A comparison of the stability of the two ships shows that there is a much more uniform measure of stability in the proposed ship, and the design lessens considerably the variation in the metacentric height between the light and load conditions. Regarding trim, another important factor which is embodied in the non-cargo-carrying vessel is that both in the departure and arrival or light conditions the ship is practically on an even keel.

The profile drawing of the "Type" ship accompanying this paper† gives an idea of the modifications which would be made, including the subdivision, which is for a two-compartment standard ship under the ordinary assumptions.

Mr. A. C. F. Henderson welcomed the effort of the authors to evolve a type of ship which would be economical to operate and satisfactory to her owners, but the question required a little more consideration from the point of view of the evolution of type that had gradually been taking place in the last few years. The authors of the paper stated that their remarks were directed principally towards Atlantic passenger vessels. To-day, there were the three types—the express ship of large tonnage and high speed ; the diminishing three-class ship of moderate dimensions and speed ; and the cabin ship. The first type realised the ideal of the authors of the paper, as they were purely passenger vessels and carried little or no cargo, but as regarded the elimination of cargo from either of the other two types, that was impracticable. The development had rather been towards increasing the percentage volume occupied by cargo over the types existing immediately pre-war, although it was possible the trend had been too much in that direction. It must not be forgotten that a ship was constructed not for service for a limited number of years, but for service for her whole life, and the intelligent owner tried to forecast conditions which would exist during the period of that vessel's life On the questions of the trim of a vessel carrying cargo and also of the arrangement of hatches, derricks, &c., it was quite true to say that they presented considerable difficulty when combined with passengers, and it would be much more preferable to eliminate them. They did not, however, present any difficulty which practice and naval architecture could not overcome, and such being the case, he did regard this as an argument for the elimination of cargo carrying. It was in Table II. that the whole crux of the matter rested. The authors showed that to make the type ship as economical as the proposed ship, and assuming full cargoes were obtainable both ways, required nearly 14s. a ton, exclusive of handling. The figures were not borne out in practice, and without further details of the authors' data, he emphatically stated that ships on the North Atlantic to-day, outside the express type, could not do without their cargo capacity if they were to be run on an economic basis. Whilst welcoming most heartily the paper, he would suggest

* No. I. appeared June 27th, 1924.

† Not reproduced.—ED. THE E.

that whilst radical and sudden alterations in propelling power and other integral parts of a ship were possible, ship types were a matter of evolution and progress, and must of necessity be slow. Shipowners had to supply a service to the public, but that service could only be supplied on an economic basis.

Mr. R. J. Walker contended that for passenger ships' service, and particularly for big ships, the geared turbine would remain the best machinery installation. He claimed that recent improvements had resulted in economies of operation which raised the thermal efficiency of the steam turbine to an equality with that of the oil engine.

Following the meeting on Wednesday morning an afternoon reception was held at Syon House, Brentford, by the President and Her Grace the Duchess of Northumberland, and in the evening a dinner took place at the Connaught Rooms, as reported in our last issue.

The Thursday was devoted to a visit to the British Empire Exhibition, arrangements being made for an inspection of the engineering, shipping and shipbuilding exhibits under competent guides. A luncheon was given after the morning visit to Wembley at the Great Central Hotel, Marylebone.

The Duke of Devonshire, who was present in his capacity as chairman of the Executive Council of the Exhibition, said that although those who had organised the great display at Wembley hoped that the enterprise would meet its liabilities and be able to pay 20s. in the pound, the objects sought were far wider in scope than that of achieving financial success. The Exhibition had not only enabled large numbers of people to realise the meaning of the British Empire and its resources, but the rising generation, through the visits of school children, were being educated on the subject, and the world at large, through foreign visitors, was gaining a knowledge of the Empire such as would not have been possible in any other way. Other nations were being taught something of the great opportunities possessed by the British Empire, and its power of contributing, not only to development in its own interest, but to the happiness and prosperity of the world in general.

A reception was held by H.M. Government at Lancaster House on Thursday evening.

The Conference reassembled in the Lecture Hall of the Institution of Civil Engineers, under the presidency of the Duke of Northumberland, on June 27th.

After the names of candidates recommended for election by the Council of the Institution of Naval Architects had been read by the Secretary and voted upon, Sir Archibald Ross, president of the North-East Coast Institution of Engineers and Shipbuilders, read, on behalf of that Society, his paper on "The Progress in Marine Propulsion during the Last Ten Years and some of its Possiblities." This paper is given in full on page 22.

Mr. Harold Yarrow, who opened the discussion, said that he was glad to hear what the author had said about the steam engine and the possibilities associated with higher pressures and superheating. In this direction lay hopes of a distinct improvement in the efficiency of the older type of prime mover. It would be interesting to have some definite figures as to the consumption of oil when used as fuel for steam-raising purposes, as compared with the consumption of fuel in the oil engine. His own opinion was that, compared with the improvement of the oil engine, the steam engine had made a greater relative advance during the past ten years. At the present time the marine internal combustion engine was limited in application to high speed and shallow-draught vessels, owing to the difficulty of obtaining high powers in association with reasonable weight.

Mr. D. C. Endert commented on the fact that British engineers had waited a long time before giving serious attention to the marine oil engine. During the last year or two, however, all the leading firms of marine engineers had taken up the manufacture of Diesel engines in a manner which suggested that their continental competitors would have to pull themselves together to overcome the rivalry of British firms. The question which should now receive attention was to reduce the cost of the marine internal combustion engine, and that could only be done by deciding on a type and laying down plant and machinery for production on a large scale. That was a big item, and he invited an expression of opinion from Sir Archibald Ross on that point.

Professor Gross, a delegate from the American Society of Naval Architects, quoted some figures in connection with the operating costs of Diesel-electric ferry boats which were in service in San Francisco Bay. The boats referred to ran on a twelve minutes' schedule. The installation was of the Werkspoor electric type, and he believed the fuel consumption came out at 0.50 lb. per shaft horse-power per hour. The choice between Diesel-electric and other systems turned on the question of flexibility and not on fuel costs. In turbo-electric boats the fuel consumption was about 1 lb. per shaft horse-power per hour. The control system of the ferry boats was direct, starting and stopping being effected by the captain. The United States Shipping Board had decided, on the ground of high fuel consumption, not to fit any more ships with the turbo-electric drive. In practice fuel consumption on ships so fitted had been as high as 1.3 lb. to 1.5 lb. per shaft horse-power per hour. It would appear, therefore, that the electric drive was only applicable where great flexibility and quick reversing was an essential element of the service and the fuel bill a secondary consideration.

Sir Archibald Denny admitted that, although British engineering firms were now showing great energy in the manufacture of the marine Diesel engine, they had waited until the success of that type of prime mover appeared to be assured before entering the new field. The late Lord Pirrie, whose death was so lamented, had had a large share in the development of this branch of marine engineering in Great Britain. To-day, from the mechanical point of view, the internal combustion engine was very successful, and, as had been stated by other speakers, the immediate problem was the reduction of weight in relation to power developed. The author asked whether it was to be assumed that the steam turbine, and indeed the steam engine generally, had had its death sentence pronounced, and answered his own question in the negative. He (Sir Archibald Denny) agreed with the author's remarks, and he would be very much surprised if the brilliant invention of the steam turbine did not succeed in a life-saving effort. On the subject of the failures which had taken place in reduction gears, he thought that it was an error to assume that the majority of failures had occurred in double reduction gearing installations.

Mr. H. Sumners Hunter said that the paper had been written at a most opportune time in the history of ship propulsion machinery. Some of the points raised by the author, such as higher pressures and temperatures in all types of marine engines, had been receiving attention for a number of years. Materials of construction were now receiving careful consideration. These researches, if any useful results was to be achieved, must go on continuously. It would be a good thing if such investigations could be carried out by the industry as a whole, but as that ideal seemed almost impossible to realise, the work must be done by individual firms. The thing that mattered was that the information and experience gained in this way should be made available to others for the benefit of the industry. The training of engineers to obtain the best results from the new types of prime mover was being achieved. There was no lack of young engineers, and no shortage would arise if shipowners and others would grant young engineers opportunities of acquiring the necessary experience. The fuel question he regarded as one of supply and demand, but he ventured to think that as long as Great Britain and the British Empire possessed coal it would be used directly or indirectly for the generation of power for the propulsion of ships.

Mr. Howden Hume agreed with those who predicted a future for the steam engine. The use of higher pressures had, he said, been bound up with the employment of water-tube boilers, and these had not been adopted in merchant ships except to a very slight extent. The line of progress was apparently the design of a cylindrical type boiler suitable for high pressures, and he ventured to predict that a boiler in which that would be possible would be brought to the notice of engineers within the next few weeks.

Mr. A. F. Ainslie dealt with the question of flexibility in gearing and the need of retaining with the desired degree of flexibility the necessary rigidity of bearings to enable centres to keep their relative position.

Sir Archibald Ross, in his reply, referred to the fine pioneer work of Dutch engineers in connection with the marine Diesel engine, without any certainty that the work would prove successful in the commercial sense. He did not wish to be misunderstood about double reduction gearing; his point was that more had been heard of trouble in connection with double than single reduction gears. It was a fact familiar to most of them that double reduction gears had not been fitted in warships and that trouble with gearing was practically unknown in the Navy.

NEW TYPE OF DOUBLE-ACTING ENGINE.

Mr. G. J. Lugt then presented the paper of which he is joint author with Mr. Harry Hunter, "A New Type of Double-acting Diesel Engine for Marine Purposes." A summary of this paper is given on page 23.

Monsieur Doyère described the paper as an important contribution to one of the questions of the hour. Those present were aware that very little use was being made by French shipowners of the Diesel engine in mercantile vessels. The French Admiralty was, however, much interested in the subject of light weight Diesel engines for submarines, and he would like to know if Mr. Lugt was carrying out any experiments with the object of obtaining a reduction of weight for a given power. It would be a great advantage if to the achievements made with the engine described, which were considerable, could be added an appreciable saving in weight.

Mr. Lambrechtsen reminded the Conference that the Werkspoor Company fitted out the Vulcanus, the first sea-going vessel in which the Diesel engine was employed for purposes of propulsion. That ship was still in service. The Werkspoor Company was associated also with the latest type of Diesel engine described in the paper. Looking at the design from the point of view of a superintending engineer, he noted improvements in other types of double-acting Diesels. The British Empire Exhibition contained several examples of double-acting engines, and he, as representing shipowners, would experience great difficulty in making a choice. He could not help thinking, however, that the rivalry of the internal combustion engine would lead to improvements being effected in the steam engine, which had in a marked degree the merits of simplicity and reliability. The fuel consumption of marine type of Diesel motors had been reduced to from 0.40 lb. to 0.45 lb. per brake horse-power hour for all purposes, but having regard to the price of oil and the fuel costs of the steam engine, he was afraid that it would be difficult to persuade shipowners to order motor ships for long voyage cargo service. With oil as the only fuel and no possibility, as in the case of the steamship of using coal if desired, the owner who relied on motor ships would be at the mercy of the powerful oil companies, who could put up prices as they pleased.

Sir Robert Dixon, while welcoming the paper, said that from the point of view of Admiralty requirements, the weight of the new engine and the space required ruled it out of consideration for warships. At the same time he recognised that any engine which was to be used by the Navy would be of the double-acting two-cycle type, as that form would enable the weight of the installation and the space required to be reduced. The authors enumerated the difficulties associated with the design of a double-acting engine and showed how they had been overcome. This had only been done, however, by some sacrifice of the efficiency of combustion and the acceptance of a less even turning moment. Experience with the Fritz, which was built in Germany in 1913 and fitted with a double-acting two-cycle engine, suggested that the difficulties which this type of engine presented had been exaggerated. In connection with the authors' design of valves for the lower combustion space, which were operated by long push rods, he assumed that some allowance was made for expansion in the rods. The method of dealing with leakage from the piston rings was ingenious, but he questioned whether it was worth doing. He was glad to see that the new design provided the quality of accessibility which was of the first importance, and had been so flagrantly disregarded in the early designs of oil engines.

Sir James Henderson referred to the late Prof. Bertram Hopkinson's work on the effect of radiation in engine cylinders and asked if the authors had used polished combustion surfaces to reduce radiation.

Mr. Harry Hunter, who replied to the discussion, said that the engine had been designed for merchant ships, but there was no reason why the principle underlying the design should not be employed in the construction of engines for submarines. A reduction in weight was possible and with it a reduction in fuel consumption. Sir Robert Dixon had made a point of the uneven turning moment, but in a six-cylinder engine this defect would tend to disappear. The same speaker had asked whether provision was made for expansion of the push rods. The only point where this was necessary was in the fuel valve. In reply to the last speaker, he said that polished surfaces had not been used.

The last paper on the agenda was presented on behalf of the Institution of Engineers and Shipbuilders in Scotland by Mr. W. H. Riddlesworth. In it was described some approximate formulæ, based on a study of block coefficients, which have been used in the Fairfield shipyard for some years, and have been found to be of considerable labour-saving value in the preparation of estimates and designs, for which a knowledge of the draught and the displacement of a ship under various conditions of loading is required. The paper was illustrated by curves showing a comparison between actual and calculated block coefficients and displacements. The author also described and exhibited a rotary form of slide rule, which had been designed to facilitate approximate calculations based on the formulæ given in the paper.

Professor P. Hillhouse and Professor J. J. Welch both referred to the utility of the methods described and commended them to the attention of naval architects. Mr. Riddlesworth briefly replied.

Mr. W. H. Whiting proposed a vote of thanks to the President, and referred to the conspicuous judgment and ability he had shown in presiding over the meetings of the session. The Institution also owed their President much, he said, for the work he had done in the private meetings of the Council, which had led up to the formation of the Joint Engineering Council. Professor J. J. Welch seconded the resolution, which was carried with acclamation.

After the morning session a large party of the guests attending the meeting were entertained to luncheon by the Committee of Lloyd's Register of Shipping at the offices of the Society, 71, Fenchurch-street. The guests were welcomed by Mr. J. Herbert Scrutton, the chairman of Lloyd's Register, who was supported by Sir Thomas J. Storey, deputy chairman, and members of the General Committee. The toast of "The Institution of Naval Architects" was proposed by Mr. Scrutton, and was replied to by the Duke of Northumberland, the President of the Institution.

LIVERPOOL AND MANCHESTER RAILWAY—LOCOMOTIVE "MANCHESTER," 1832

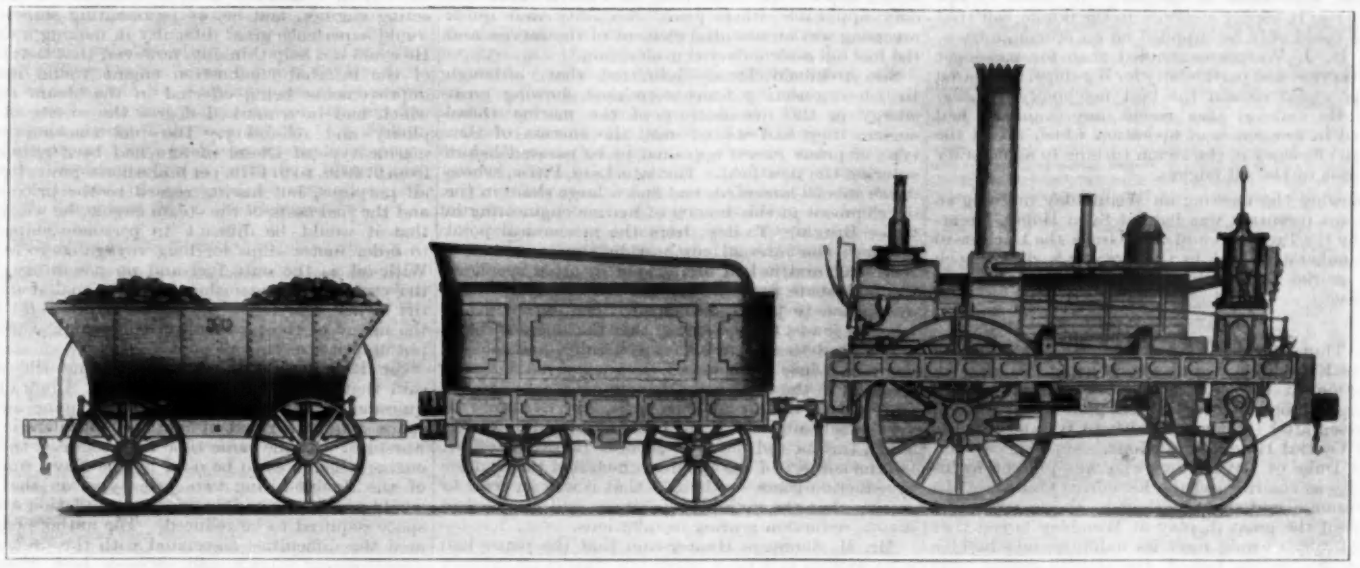


FIG. 1

In the afternoon of Friday, June 27th, those attending the Conference were given an opportunity, of which many took advantage, of making a trip in the Golden Eagle on the lower reaches of the Thames.

At night a concert, followed by a supper and dance, was given at the Hotel Cecil, and proved to be an extremely enjoyable function.

Special arrangements were made on Saturday morning last for a demonstration at the William Froude Tank at the National Physical Laboratory, Teddington. Visitors were received by Sir Joseph Petavel, director of the Laboratory, and Mr. G. S. Baker, the superintendent of the Tank. The preparation and testing of models was explained by Mr. Baker, Mr. Kent and Miss Keary, and opportunity was given for some members of the party to see other sections of the Laboratory, including the aeronautical section.

Later in the day a visit was paid to Windsor Castle, and an opportunity given of a trip on some of the upper reaches of the river Thames.

VISITS TO GLASGOW AND NEWCASTLE.

The programme arranged for the short visits to Glasgow and the North-East Coast attracted a considerable number of members of the three institutions and foreign guests. Leaving London on Sunday last, those taking part in the trip proceeded to Glasgow.

Monday was a day of entertainment. In the morning the party embarked on the Duchess of Argyll at the Broomielaw for a sail down the Clyde, which gave foreign guests an opportunity, either of renewing their acquaintance with this great centre of the shipbuilding industry or of seeing for the first time some of the famous establishments on both banks of the Clyde. The destination was Brodick, in the Isle of Arran, where the party was received by the Marquis and Marchioness of Graham in traditional fashion. The characteristic Highland welcome was much enjoyed by foreign guests. Fine weather favoured what was in all respects a pleasant experience.

In the evening, under the presidency of Mr. J. Howden Hume, President of the Scottish Institution, a banquet was given at the Grosvenor Restaurant, Glasgow. It was a representative gathering and foreign visitors followed with interest the time-honoured ceremony of serving the haggis. The toast of "The Guests" was in the capable hands of Lord Weir.

The programme for Tuesday last was made up of visits to the yards and engine shops of the Fairfield Shipbuilding and Engineering Company, and to the works of G. and J. Weir, Limited. At Fairfield visitors saw on the stocks the twin-screwed geared turbine oil-fuelled Anchor Donaldson liner Letitia, of 13,500 tons; the Transylvania, of 17,000 tons, also a twin-screw, geared turbine, oil fuel ship; and the keels of H.M.S. light cruiser Berwick, of 10,000 tons, and of a new large Diesel-engined refrigerated meat-carrying vessel, which is being constructed for the Houlder Line. Afloat in the basin was the Aorangi, the 17,500 tons four-screw Diesel-engined ship recently launched for the Union Steamship Company of New Zealand, and the largest motor-driven passenger ship which has yet been built. In the engine works one of the four sets of Fairfield-Sulzer motors, developing about 3250 brake horse-power, which are to be installed in the Aorangi, was inspected.

The visit to the works of G. and J. Weir, Limited, also revealed many features of interest, a wide range of productions in various stages being on view.

Luncheon was served at both Fairfield and Cathcart after the tours of the yard and shops.

On Tuesday evening a special train conveyed to Newcastle those who were anxious to obtain a glimpse of some of the North-East Coast yards and works. Among the companies which threw their establishments open to inspection were Sir W. G. Armstrong, Whitworth and Co.; Palmer's Shipbuilding and Iron Company; R. and W. Hawthorn, Leslie and Co.; Wallsend Slipway and Engineering Company; Swan, Hunter and Wigham Richardson; the North-Eastern Marine Engineering Company; C. A. Parsons and Co.; Richardsons, Westgarth and Co.; Dorman, Long and Co.; the Furness Shipbuilding Company; William Gray and Co.; and the Central Marine Engine Works.

Reference may be made to some of the items which attracted attention at some of these establishments, but it is impossible to give more than a slight impression of the work now in hand and developments in progress, as all the visits included in the official programme were compressed within a single day. At Wallsend were seen under construction the boilers for the new battleship H.M.S. Nelson. In the erecting shop at these works attention was directed to the air injection oil engine of the two-stroke single-acting Wallsend-Sulzer type. This engine has four cylinders, 600 mm. bore by 1200 mm. stroke, and is designed to develop 1800 brake horse-power at 90 revolutions per minute on regular service. Shop trials have just been completed, and the engine is to be shipped almost immediately in a single-screw vessel. The oil-burning apparatus department was inspected with interest, and thirteen installations for burning liquid fuel were seen in various stages of construction.

At Hawthorn, Leslie and Co.'s engine works two sets of twin-screw quadruple-expansion engines, which are under construction for a P. and O. liner, were on view, as well as a pair of four-crank triple-expansion engines for the twin-screw British India liner Talamba. These engines are completed and are ready for putting on board. The shops also contained a twin-screw set of Hawthorn-Werkspoor-Diesel engines which are completed and ready for installation in a vessel which is under construction at a Clyde yard. Other interesting work in hand includes the turbine machinery for a 10,000-ton cruiser, but this work is only in the preparatory stage.

Visitors to the North-Eastern Marine Company's works displayed chief interest in a large double-acting four-cycle marine Diesel engine, which is capable of developing 1000 indicated horse-power. This engine was running under load on Wednesday. An eight-cylinder four-cycle Diesel engine was in course of construction. The special iron castings for Diesel engines attracted favourable comment.

Those who took part in the visit to Doxfords at Sunderland found that the whole of the engine shops had been re-organised and extended, and the output capacity doubled, within a comparatively recent period. Several examples of the opposed-piston type of engine were on view, and it was stated that the Eknaren, one of the single-screw vessels equipped with this type of engine, has just completed a non-stop run of 12,250 miles in a period of fifty days between Port Pirrie (Australia) and Bordeaux.

For those members of the party who did not wish to visit engineering works and shipyards, an interesting alternative visit was arranged to inspect the Roman wall at Borcovicus (Housesteads). The party was in the capable hands of Mr. E. R. Newbigin and other members of the Northumberland and Durham Archæological Society.

On Wednesday evening, a farewell banquet was given by the North-East Coast Institution of Engineers and Shipbuilders in the Grand Assembly Rooms, Barras Bridge, Newcastle-on-Tyne, and the joint meeting closed with the return of the main party from Newcastle to London on Thursday morning.

This joint meeting will long be remembered by the friendly exchange of opinions which took place, and the excellent arrangements which were made in London and on the Clyde and Tyne for the entertainment of the guests visiting our shores. The unqualified success of the meeting was due in no small measure to the work of the reception committees of the three Institutions, and particularly to Mr. R. W. Dana, secretary of the Institution of Naval Architects; Mr. Edward H. Parker, secretary of the Institution of Engineers and Shipbuilders in Scotland; and to Mr. E. W. Fraser-Smith, secretary of the North-East Coast Institution of Engineers and Shipbuilders.

Locomotive No. 28, Liverpool and Manchester Railway.

By C. F. DENDY MARSHALL, M.I. Loco. E.

DURING the first year or two of the existence of the Liverpool and Manchester Railway a good deal of criticism was levelled against the directors, on the ground that practically all the engines were both designed and built by the Stephensons, whilst even those few which were constructed by other firms were nearly all from the Stephenson drawings. It was said that no other locomotive builders had a chance of getting their engines accepted. The fact was, however, that there was no one else at the time who knew how to design a locomotive which could approach the Stephenson engines for efficiency—with the possible exception of Edward Bury. The first twenty-five engines were all Stephenson designs, of three different types; the twenty-sixth was built by Bury, but he was not allowed to carry out his own ideas, and had to work on the lines of the "Planet."

The engine which forms the subject of this article was the first complete departure from the Stephenson type. She was built in 1832 by Messrs. Galloway, Bowman and Glasgow, of Manchester—now known all over the world as "Galloways, Limited." Fig. 1 is a reproduction of a print I have recently acquired, which agrees exactly with an old drawing in the possession of Messrs. Galloway, and evidently shows the original state of this curious engine. Her name was originally "Manchester," and it will be seen that, besides having the proud distinction of being the first locomotive to be built in that city, she also possessed the unique peculiarity of having the chimney in the middle of the boiler, the gases returning to an annular smoke-box by means of a duct under the barrel. Tradition says that she used to lift herself off the rails, which seems by no means unlikely. Interesting traces of the influence of Braithwaite and Ericsson's "William IV." and "Queen Adelaide" can be seen in the little ornaments in the Adam taste which fill up the right angle of the frame behind the driving wheel, and those on each side of the small panels under both engine and tender frames.

Fig. 2 shows the engine as reconstructed, with the name changed to "Caledonian." The cylinders were then placed centrally, while the smoke-box and chimney are in the normal position. The flagstaff belongs to the background. This illustration is taken from a lithograph in a pamphlet entitled "The Railway Companion, Describing an Excursion Along the Liverpool Line, Accompanied with a Succinct

and Popular History of the Rise and Progress of Rail-Roads," by a Tourist, 1833. It is repeated in a "Descriptive Catalogue of the Padorama (*sic*) of the Manchester and Liverpool Rail-road, Containing 10,000 square feet of Canvas, now Exhibiting at Baker Street, Portman Square," 1834. From the fact that only this one engine is illustrated in these pamphlets, it may be inferred that at last she was performing satisfactorily.

A small outline sketch of the same engine is given in a paper read before the Cleveland Institution of Engineers by Theodore West in 1886, in which she is represented in what may quite possibly have been an intermediate state. The cylinders are in the same position as in Fig. 1, but instead of actuating a dummy shaft, they drive the leading wheels, which are increased in size and coupled to the others. One feels, however, rather doubtful about placing much reliance on this drawing, because the boiler is a different one, having a haystack fire-box. The chimney and smoke-box are normal.

In "The Locomotive and its Development," Stretton illustrates her exactly like West, going on to say that she was rebuilt with inside cylinders and a crank axle, which is evidently not correct. Whether these two drawings have any foundation in fact or not, they nevertheless supply a connecting link between Figs. 1 and 2, since West calls her the "Manchester," and Stretton the "Caledonian."

I think my readers will agree that she forms an exceptionally interesting "link in the history of the locomotive," both on account of the source from which she came, and of her very remarkable design.

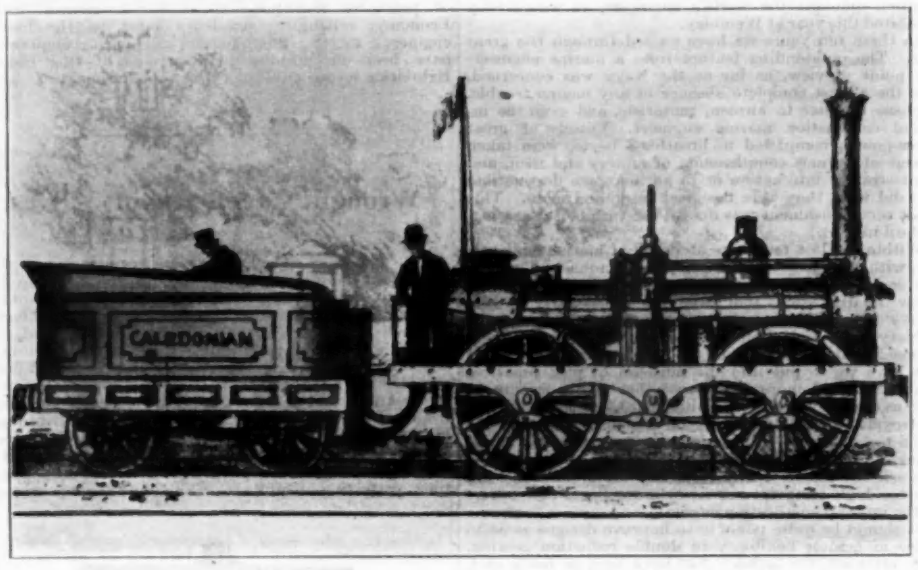


FIG. 2—THE LOCOMOTIVE "CALEDONIAN"

Short-wave Directional Wireless.

LAST Wednesday afternoon Senator Marconi read an important paper at the Royal Society of Arts, entitled "Results Obtained Over Very Long Distances by Short Wave Directional Wireless Telegraphy, more particularly referred to as the Beam System." The reflectors now used are composed of a comparatively small number of wires placed parallel to the antenna and spaced around it on a parabolic curve, of which the transmitting or receiving antenna constitutes the focal line. Since 1916 various patents have been taken out by Senator Marconi and Mr. C. S. Franklin, and in the latest of these patents Mr. Franklin describes an arrangement in which the antenna and reflector wires are arranged so as to constitute grids parallel to each other. The aerials are energised simultaneously from the transmitter at a number of feeding points, through a special feeding system, so as to ensure that the phases of the oscillations in all the wires are the same, the directional effort of the arrangement being a function of the dimensions, relatively to the wave length employed.

The general impressions prevailing amongst most technical experts concerning short waves are:—(1) Their range during the day-time is variable and short; (2) the night ranges are exceedingly variable and freaky, and too unreliable for commercial work; and (3) a considerable amount of intervening land or mountains very seriously reduces the distances over which it is possible to communicate. Tests carried out between Poldhu and Senator Marconi's yacht the Elettra, have shown that these conclusions are erroneous; at least in so far as 100-metre waves are concerned. The day ranges have proved to be reliable, and not inconsiderable. The night ranges are much greater than anyone had previously anticipated, and intervening land and large portions of continents do not present any serious obstacle to the propagation of these waves. The tests have revealed the fact that in dealing with short waves, it is by no means correct to refer to distances covered during daylight as daylight ranges, as the strength of the signals which can be received during daylight varies definitely and regularly in accordance with the mean altitude of the sun when above the horizon over the space or region intervening between the two stations.

During Senator Marconi's tests the Austin formula for the propagation of the waves was found to be defective when applied to short-wave phenomena. The tests have shown that for short waves of the order of 100 m., the constant must be replaced by a variable, which is a linear function of the mean altitude of the sun, calculated on the distance between the transmitting and receiving stations. In other words, the coefficient of absorption is a function of the time, the seasons and the relative geographical situation of the stations, and can now easily be ascertained for wave lengths of the order of 100 m. In their propagation, short waves behave quite differently to long waves.

During the daytime the atmospheric disturbances appeared to be less severe with these short waves than they are when working with the longer waves. Senator Marconi referred to various long-distance tests carried out with these short waves, and when using very small powers. During night time, even when receiving at St. Vincent, which is 2330 nautical miles from Poldhu and well within the Tropics, the strength of the received signals was so great that the atmospherics did not interfere in any way with the reception of signals or messages from Poldhu, where the input to the valves only amounted to 12 kilowatts, the radiation from the aerial being approximately 9 kilowatts. The parabolic reflector concentrated the energy towards Cape Verde and gave in that direction a field strength which would have required a radiation of approximately 120 kilowatts from the aerial without a reflector. During the cruise it was found that intervening land did not cut off the signals.

Since February of this year a further series of tests have been carried out over ranges which included the greatest possible distances separating any two places on the earth. A special short-wave receiver was installed on the ss. Cedric, and tests were carried out with Poldhu during a journey of this vessel to New York and back, no reflectors being employed at either end. The power supplied to the main transmitting valves was 21 kilowatts, giving a radiation of approximately 17 kilowatts. Signals could be received during daytime up to a distance of 1400 nautical miles, and the theory that the signal strength varies in accordance with the mean altitude of the sun was confirmed.

Signals of great intensity were received at Long Island, New York, during the hours when darkness extended over the whole distance separating the stations, and of less intensity when the sun was above the horizon at either end, the intensity of the signals varying inversely in proportion to the mean altitude of the sun when above the horizon.

With rather experimental arrangements at Poldhu, intelligent speech was transmitted for the first time in history between England and Sydney on Friday, May 30th, of this year. The wave length was 92 m., and the independent drive was used for controlling the main oil-cooled valves. The total power supplied to the valves was approximately 28 kilowatts.

No reflector was used. Senator Marconi expressed the opinion, however, that properly designed reflectors, even if of comparatively moderate size, will enormously increase the effective strength of signals. He is convinced that by means of this system, economical and efficient low-power stations can be established, which will maintain direct high-speed services with the most distant parts of the globe during a considerable number of fixed hours per day. Moreover, by means of these comparatively small stations, a far greater number of words per twenty-four hours could be transmitted between England, India and her distant Dominions than would be possible by means of the previously planned powerful and expensive stations.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

RAILWAY ELECTRIFICATION.

SIR,—In taking part in a discussion while so far distant from the scene thereof, the main difficulty is that the interest in the subject may possibly have subsided before the contestant again ambles into the fray. To keep this discussion within defined limits, it is necessary to repeat that it primarily concerns main-line electrification in England. Mr. George Gibbs' example of electric traction applied to long main lines, upon which the service is conducted by heavy and infrequent trains, does not apply, I think, to English railways on the same scale as to American. In England structural limitations will always keep the weight per axle lower than that which obtains in America, and a comparative shortness of main lines will similarly tend to limit the length of the train. Approach to an equally high traffic density will involve a frequent, and therefore fast, freight service, with a schedule not greatly different from inter-town passenger traffic.

Electric power distribution in England has taken on a like aspect. The arrangement of electricity supply districts is such that the necessity does not arise for long transmission lines, and, as a consequence, for the enormously high potentials that are essential in certain parts of America. There is no important main line in England that will not fall within at least two supply districts. Mr. Gibbs will admit that the temptation to "mess up" railway and power supply requirements is very strong.

The joint consideration of electric supply and traction is, I think, only natural in England, and I was always under the impression that the decision of the British Committee on Electric Traction was governed to a very great extent by this influence. Mr. Gibbs infers that the decision in favour of direct current was due to a lack of experience of other and better systems; but would it not be fairer to assume that it was because, unlike Switzerland or Sweden, the country was not already committed to any one system? In the case of France, a like decision was carried in the face of the fact that the Midi Railway had to incur the expense of a complete change-over to direct current.

As an alternative to deriving the standard in traction from the scheme of supply, Mr. Gibbs prefers to consider the railway problem as principally one of current collection. Even upon his own ground, viz., heavy trains and an infrequent service, the experience of the Chicago, Milwaukee and St. Paul Railway does not seem to indicate that current collection at 3000 volts is anything like the impossible problem he would demonstrate. If the traffic hypothesis stated above is a correct one, English main-line locomotives for either passenger or freight service should not greatly exceed 1000 horse-power at the one-hour rating, and at 3000 volts with two pantagraphs per locomotive, there should be no difficulty in collecting at either maximum current or maximum speed.

Mr. Gibbs was, of course, considering electric traction over American main lines; but even so the action of the largest manufacturing company in the world and pioneer of electric traction in definitely abandoning all systems except the direct-current system is significant.

T. E. WILLIAMS.

Johannesburg, South Africa.

[Mr. Gibbs' views on the French policy will be found in our issue of July 29th, 1921.—ED. THE E.]

COST OF SHEET METAL PUNCHINGS.

SIR,—Mr. A. Williams Price's letter—THE ENGINEER, June 27th, page 721—is of interest, in that it shows that there are others who are alive to the fact that the distribution of the cost of scrap from sheet metal punchings still remains, in many factories, in an unsettled and unsatisfactory position.

Only by the correct presentation of all the facts in their true light can there be found a method of distribution which keeps the producer aware of the proportion of scrap he is making, and which will offer a solution, equitable both to the producer and the consumer.

The figures given in Mr. Price's letter exemplify four alternative methods of distribution, but they are all open to criticism, for the reasons given in my article, the whole trend of argument in which went to show that it was not from the point of view of scrap that the distribution should be made, but from the point of view of the total material used. Mr. Price gives no hint as to which of the four methods he cites is to be considered correct, much less any reasons for such a choice as might be made. He suggests no theoretical grounds upon which he has been led to choose, for instance, the logarithmic method of distribution.

Real progress in the realms of manufacture has, in the past, always been made by the adaption of theoretically correct solutions to practical conditions, and it was from such a standpoint that I essayed to write.

F. C. LAWRENCE.

Manchester, July 1st.

SISAL HEMP PRODUCTION IN THE EMPIRE.—Sisal hemp is chiefly produced in Mexico, where the annual output is about 150,000 tons. More than nine-tenths of the amount goes to the United States, where it is employed for the manufacture of the binder twine used in harvesting the immense grain crops of the Western States, the demand for binder twine for this purpose amounting to about 200 million pounds annually. It is obvious, therefore, that European buyers must look to countries other than Mexico for adequate supplies of the fibre. A useful *résumé* of the present position of sisal hemp cultivation in the British Empire is given in the current issue of the *Bulletin* of the Imperial Institute, just published by Mr. John Murray. East African sisal, produced in Tanganyika and Kenya Colony, is of excellent quality, and large quantities come to this country, where it realises prices higher than those of Mexican sisal. The Bahamas also grow the fibre on a fairly extensive scale, but the whole of their output is taken by the United States. No other country in the Empire is at present producing large quantities of the fibre, but commercial supplies may be expected in the near future from Ceylon, Nyasaland, Gold Coast, Mauritius and Jamaica. Several other regions are well adapted to the crop and have extensive areas available for cultivation.

Ten Years' Progress in Marine Propulsion.*

By Sir ARCHIBALD C. ROSS, K.B.E., President, North-East Coast Institution.

ON an occasion of such interest as the British Empire Exhibition and the joint meeting of our three Institutions, honoured by the presence of so many distinguished foreign guests, it has been suggested that a short review of the progress during the last ten years, and the possibilities of marine engineering might be of some value if only as a milestone in the development of the industries with which we here are so intimately associated.

I do not propose to deal with this colossal subject in any great detail, and I realise very fully the inevitable plagiarism involved in even recapitulating the work of the marine engineers of this country since our last joint meeting at Newcastle in 1914. At that meeting I had the honour to contribute a paper entitled "The Progress of the Marine Steam Engine on the North-East Coast During the Last Fifteen Years." Possibly the most interesting feature of that review is that the title then used is no longer comprehensive, and I have, therefore, called my present paper "The Progress in Marine Propulsion During the Last Ten Years and some of its Possibilities."

The obvious reason for this is the wonderful work done by engineers in the development of the internal combustion engine. One can only regard this development as a very remarkable proof of the spirit of enterprise amongst marine engineers especially during the last few years, years of extreme depression in trade, when competition to procure work even on known ground has been little short of suicidal. I doubt whether sufficient credit and honour can ever be paid to the many large and small firms who have spared neither thought nor money in departing from their standards and traditions, and in striving for further economies in fuel consumption by applying their efforts to this important subject. One hesitates to mention the firms individually for fear of unintentional omission, and yet, on the other hand, if this paper is ever referred to again it may be instructive to see who are the pioneers and benefactors and who stood the test of time.

Not only the work in developing the internal combustion engine should be mentioned, but its adoption in very large numbers by the mercantile marine of this and other countries. In 1914 to have prophesied that a 9000-ton deadweight vessel would be run at 11 knots on 9½ tons of crude oil fuel per 24 hours would have provoked incredulity, but such vessels are in service to-day. It would have been likewise incorrect, though not inconceivable, to predict that the rivalry between the four-stroke and the two-stroke engines would have been nearer solution. The competition would appear now to concentrate more on the possibilities of the double-acting engine of each type. We have at present in this country some dozen types of marine internal combustion engines under the eye of the shipowner. One cannot give any one type pre-eminence, but signs are not lacking that the goal aimed at is a double-acting engine which for space, weight, reliability and economy will become the favourite.

The marvel of mechanical propulsion, inaugurated when coal was a few shillings a ton and when oil was unknown, either as a steam raiser or a power agent, made the cost of fuel comparatively negligible. The outstanding feature of the engineer's many problems to-day is the imperative necessity of extracting the maximum power from the minimum amount of fuel.

In a remarkable paper on "The Problem of the World's Supply of Energy," read before the Franklin Institute in 1920 by Dr. Arrhenius, he ventured an estimate of the durability of the supplies of coal and oil, giving the former as 1500 years and the latter as only ninety years, rather less than have passed since the first steamer was built—1801, I think, say 123 years ago. If the available tonnage of to-day, representing about 65,000,000 gross tons, were in commission and were fitted for burning oil fuel under boilers or in cylinders, the amount of oil consumed at, say, 200 days' steaming per year, excluding any naval requirements, would be in the region of 45,000,000 tons per annum. Therefore, the crying need for this struggle after economy can be readily appreciated.

The investigation of the internal combustion engine in recent years has been insistent and thorough. Not only by the Institution of which I have the honour to be president, but in hundreds of different societies and works has this great work been ceaselessly carried on. The internal combustion engine, though first introduced with success into the mercantile marine on the Continent by Burmeister and Wain, Werkspoor, Sulzer and others, has naturally undergone many changes in the period under review; but possibly more has been done in this country than is appreciated, and, without attempting any detail, mention should be made of the valuable work carried out by the following marine engineering firms:—Sir W. G. Armstrong, Whitworth and Co., Limited, William Beardmore and Co., Limited, John Brown and Co., Limited, Cammell Laird and Co., Limited, William Denny and Brothers, Limited, William Doxford and Sons, Limited, Fairfield Shipbuilding and Engineering Company, Limited, Harland and Wolff, Limited, Kincaid and Co., Limited, R. and W. Hawthorn, Leslie and Co., Limited, North British Diesel Engine Works, Limited, North-Eastern Marine Engineering Company, Limited, Palmers Shipbuilding and Iron Co., Limited, Richardsons, Westgarth and Co., Limited, David Rowan and Co., Limited, Scotts' Shipbuilding and Engineering Co., Limited, Alex. Stephens and Sons, Limited, Swan, Hunter and Wigham Richardson, Limited, Vickers, Limited, Wallsend Slipway and Engineering Company, Limited. Again, the horse-power of the internal combustion engine has increased to amounts considered quite impracticable ten years ago, and we now have twin-screw vessels building in this country to be fitted with engines of 13,000 brake horse-power and 16,500 brake horse-power, and, what is more remarkable, piston speeds of over 1200ft. per minute, a speed equal to anything yet touched in high-speed steam engines even of the destroyer type.

The relative cost of coal-burning and oil-burning vessels always appears to form a somewhat unstable basis inasmuch as the selling price of either is affected, as is only natural, by the question of supply and demand; but two features appear to stand out, one being the desirability of satisfactorily burning heavy and, therefore, cheaper oils in the internal combustion engine, and saving the more precious distillates, and the other—again having regard to Professor Arrhenius's forecast—the further development of the possible economies in the use of coal as a steam raiser.

After all, the marine steam engine is far from dead. Our own Admiralty has made great advances in the use of superheat and, what is more important, the retaining of superheat at low rates of combustion. Whilst this feature is only applicable to vessels that require long periods of steaming at powers of about one-tenth of their maximum, it is of interest as marking a distinct development and one which I ventured to mention in 1914 as a probability. There is still too big a drop in thermal efficiency between the fuel and the propeller, and to us Britishers with our natural resources of coal should fall a full measure of the honour of reducing that drop. The more we do this the more will we as a nation of naval architects and marine engineers maintain our position amongst the world's engineers, so wonderfully exhibited this year at Wembley.

In these ten years we have passed through the great war. The outstanding feature from a marine engineering point of view, as far as the Navy was concerned, was the almost complete absence of any engine trouble, a phase familiar to airmen, motorists, and even the internal combustion marine engineer. Vessels of great horse-power, completed in breathless haste, were taken charge of by new complements of officers and men, and went straight into action or to an unknown destination, and did what they were designed to do and more. This great accomplishment was due to the turbine, to gearing, and oil fuel.

Within the last ten years no detail of marine engineering, with the exception of the internal combustion engine, has caused more heart searching than gearing. We all know the discussions that have taken place, and friendly passes between the metallurgist and the designer, the dubiety expressed about the material, the very greatly reduced loads on teeth and the striving after accuracy; but have we to put into the museum of past practices that which did more than any other single feature to give us our Hoods, our Warspites, our Champions and our destroyers? No, this would be a wrong conclusion to come to. There is still, as long as coal lasts and steam is used, a present and a future for gearing; but one must not ask too much of any steel any more than one can use too high temperatures in cylinder liners and covers of the internal combustion engine.

It should be quite possible to improve designs so as to allow of greater flexibility in double reduction gearing, and, after all, the failures that have been so freely and, in many cases, naturally made much of, have been chiefly in connection with double-reduction gears. As a steam engine, the turbine is not only the most economical method of generating power for marine work, though this economy cannot be realised without affecting a reduction in revolutions at the propeller, but it is essentially suitable for passenger steamers due to the absence of vibration, and so far, where high powers are required, has yet to meet its rival.

Whereas mechanical gearing has the great merit of losing only 2 to 3 per cent. mechanical efficiency, other methods of reducing gear have always and are to-day attracting serious attention, and with hydraulic transmission, advantages can be seen which, whilst not actually competing in efficiency with mechanical gearing, allow of the highest conditions of economy being introduced into the prime mover, such as high superheat applied to turbines revolving in one direction, the safer adoption of end-tightening of blading, the elimination of astern units and a probable reduction in cost of manufacture. With the practicability of adopting these and other improvements associated with higher pressures, superheat, water-tube boilers, mechanical stokers, highest vacuum and feed heating one may confidently look for further economies, and, on actual consumption of fuel per brake horse-power, to coming within more measurable distance of the internal combustion engine.

Much might be said of these possibilities; in many cases great advance has been made and one may regard their adoption as actualities. On the other hand, it is surely a sign of conservatism that there has not been a more general adoption of the water-tube boiler in the mercantile marine. The arguments against its use are well known, such as the danger of salt water, pitting of tubes, unfamiliarity with method of construction and repair; but these objections must be overcome in time, and advantage taken of the great saving in space and weight. The boiler is more dependent on the condenser than it should be. A single condenser tube has been known to stop an engine. It cannot be beyond the powers of the metallurgist and the engineer to overcome this.

In concentrating on marine engines, one should not ignore the great services rendered by metallurgists and manufacturers of material and auxiliaries in improving the performance of the marine engine. Higher pressures and temperatures demand closer investigation into metals both ferrous and non-ferrous. Much valuable experience is being gained from the latest electric-power stations, both as regards superheat and other means towards economy in steam consumption. In the case of superheat temperatures in the region of 700 deg. Fah. require the most careful choice of suitable turbine material, and one may confidently rely on the metallurgists to assist in producing suitable blading material for these temperatures without incurring the risk of erosion or too great loss of strength.

These same developments necessitate better and more efficient auxiliaries. There is much yet to be done on these lines, and in vessels of large power the proportion of overall power absorbed in doing work other than through the propeller requires as much, if not more, attention than the main engine itself.

During these ten years electric propulsion cannot be said to have made great headway, possibly due to the concentration on the internal combustion engine; but it would appear to the writer that the less intermediate stages one can introduce between the power generator, be it a boiler or an internal combustion engine, and the propeller, the less opportunity is there for losses in efficiency.

If any criticism be permitted in regard to the internal combustion engine, it is, I submit, one of comparison between the simplicity of the reciprocating or turbine steam engine and the complications associated with the internal combustion engine. These latter will, one feels certain, be overcome in time, but simplicity and first cost are second only to the fuel bill.

A review such as this can be either a work of compilation of all that has been said, written, and done in the field of marine engineering over these ten years or a discourse on generalities; the detailed ground has been very ably covered by many others. I claim originality for neither of these courses, rather am I attempting to put on record the position we have reached to-day in our profession. That position is one of expanding interest, one which calls for the personal aid and knowledge of every one concerned, from those who control the world's oil and coal supplies down, or perhaps one should say up, to the shipowner and his men who run the ship.

Only a war can justify standard vessels or engines; finality is never reached. Prejudice, supported by years of peace or monopoly, must die a natural death. Economy, reliability, simplicity must be the marine engineers' motto. Shipbuilding and marine engineering have been our peculiar heritage, and, if this Empire Exhibition means anything, they should remain so.

* Read at the joint summer meeting of the Institution of Naval Architects, Institution of Engineers and Shipbuilders in Scotland, and the North-East Coast Institution, June 27th, 1924.

Wrought Steel Steam Valves.

THE increasing use of high pressures and superheated steam in modern power plants is causing engineers to turn their attention to improved methods and more suitable material for the construction of valves. For valve bodies for such purposes cast steel is generally employed, and although this metal is an improvement upon cast iron, it is difficult to obtain steel castings entirely free from flaws, such as blow-holes, which are liable to escape detection on the test bed, and may ultimately be the cause of serious trouble. Wrought steel is free from these disadvantages, but hitherto the manufacture of valves from this material has not proved very successful. Victory Valves, Limited, of Adswood, near Stockport, has been at work for some time perfecting a process of manufacturing wrought

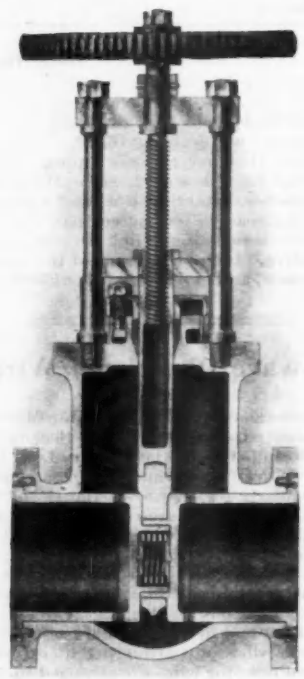


FIG. 1—FULL BORE PARALLEL SLIDE VALVE

steel valves which, it is claimed, has overcome all difficulties, the valves being lighter and safer in use than cast valves, while being accessible as regards the inner parts.

Three valves of different types made by this firm are shown herewith, Fig. 1 being a full bore parallel slide valve, Fig. 2 a junction valve, and Fig. 3 a straight-through stop valve. In all cases the bodies, branches and covers are pressed out of mild steel, welded together inside and outside. A special feature of all these valves is the detachable steel sleeves, to which stainless steel seatings are autogenously welded. These sleeves are machined inside and out, and are made an easy fit in the branches. They are secured in position by means of flanges carefully machined to make a steam-tight fit in corresponding recesses in the flange of the valve, being finally secured by means of rustless steel grub screws. A special advantage claimed for this form of seating is freedom from distortion, as the seatings are not attached to the valve bodies in the usual way, and are therefore unaffected by the expansion and contraction of the valve body. The valve discs are also of steel, with a seating surface of stainless steel. We have

had an opportunity of noting the remarkable wearing qualities of this metal in steam valves compared with brass, and the difference in favour of the former is most pronounced, the life of the stainless seatings being almost unlimited.

We have also had an opportunity of inspecting the process of manufacture of the valve bodies at the makers' works. The parallel slide valve body in its initial stage is a simple cup-shaped forging, and sufficiently strong to withstand an internal pressure of 500 lb. per square inch. This is rough turned inside and outside to ensure concentricity. On to this forging the cover and branches are welded. The cover is dealt with first and then the holes to receive the inlet and outlet branches are bored out.

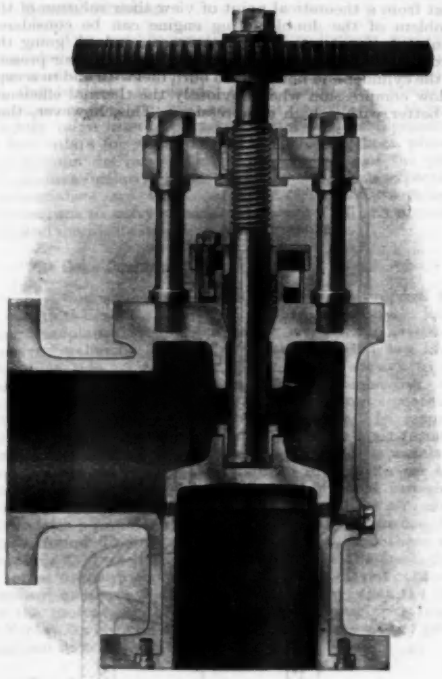


FIG. 2—JUNCTION VALVE

The branch forgings are inserted in these holes and welded inside and outside, after which they are machined. Both before and after fitting the sleeves and valve parts, the valves are tested, both by hydraulic and steam pressure up to 500 lb. per square inch. The straight-through stop valve shown in Fig. 3 differs in its construction from the former valves in that the sleeve is dispensed with and the valve has a cover held securely by means of bolts and nuts in the usual manner. Both the seating and the valve facing are made of stainless steel. All this firm's valves are fitted with Gray's safety hand wheel, which has

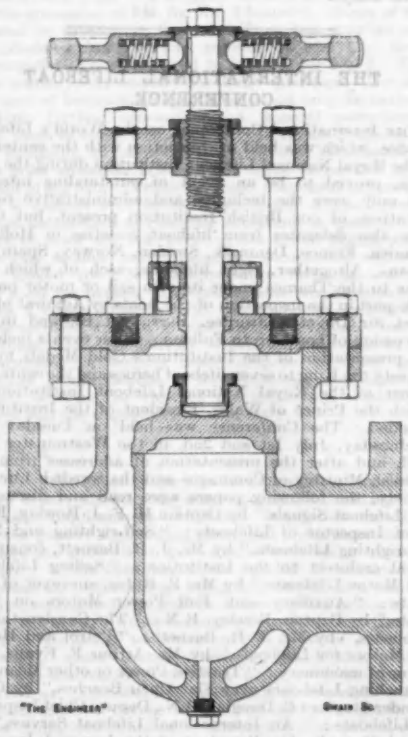


FIG. 3—STRAIGHT THROUGH VALVE

already been described in THE ENGINEER—see page 77 in our issue of January 18th last. By the use of this hand wheel, damage to the valve spindle and seating is prevented, should excessive force be used in closing the valve, as sometimes happens when crow-bars or similar tools are employed.

A New Type of Double-acting Diesel Engine.*

By G. J. LUGT and HARRY HUNTER.

IN this paper the authors give an account of a new type of double-acting Diesel engine for marine purposes. This engine, which has a piston diameter of 31½in. and a stroke of 55in., and develops in a single cylinder 600 brake horse-power at 95 revolutions per minute, has already been described in THE ENGINEER for May 30th and June 6th. We propose, therefore, not to re-describe the engine in the present article, but rather to give prominence to those parts of the paper in which fresh detail is given concerning the underlying principles of construction and the way in which the work has been carried out. The main principles of both the large and small experimental engines which have already been constructed are conveniently illustrated by the diagrammatic drawing reproduced in Fig. 1. The design is of the four-cycle double-acting type, with a bottom combustion chamber outside the main cylinder space and only connected to it by means of an ovoidal passage. This combustion and compression space is furnished with the usual air inlet, exhaust, and fuel valves, the latter valve being placed so that its axis coincide with that of the combustion chamber. A slightly lower com-

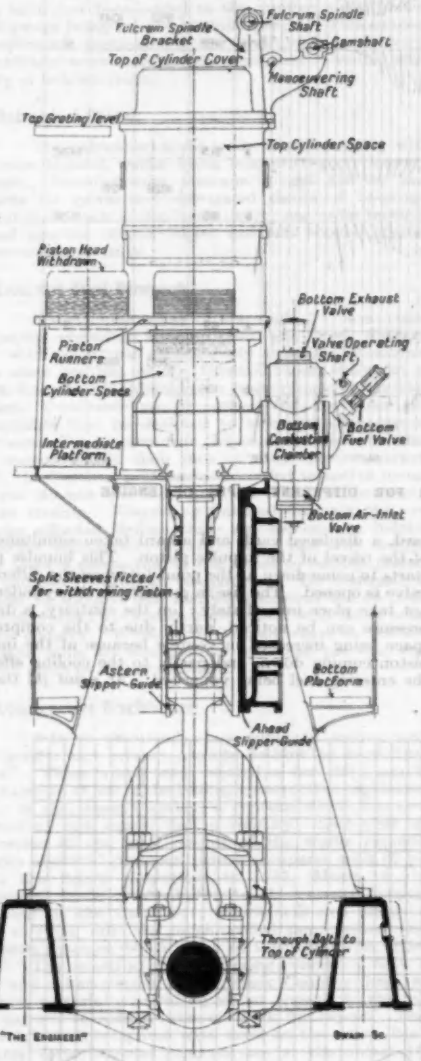


FIG. 1—SECTIONAL ELEVATION OF ENGINE

pression pressure is adopted on the bottom side of the piston than on the top, but the working pressure is sufficiently high to give self ignition when the engine is once warmed up. The exhaust gases from the top combustion space are used to warm up the bottom combustion chamber during the time the engine is being started up. With a compression pressure of 250 lb. per square inch, this process is accomplished in nearly four minutes. The arrangement of the ahead and astern guides and the method of dropping down the split cylinder casing so as to expose the piston really for examination is illustrated by drawing Fig. 1. The indicator cards reproduced in Fig. 2 serve to show the pressure conditions obtaining on either side of the piston. It may be noted that the diagram for the bottom side of the piston bears a great resemblance to a gas engine diagram. The combustion takes place at constant volume, which means that the process of combustion is carried out during the time the piston is traversing the lower dead centre. Consequently the flame never enters the cylinder and does not touch the piston-rod, which, not being exposed to direct radiation, is remarkably cool. The temperature of the piston-rod can always be tested by touching the outside of the piston-rod stuffing-box, and fusible metal plugs have shown it to be as low as from 160 to 200 deg. Fah.

In the large experimental unit previously referred to the volume of the bottom combustion space is about 3 cubic feet. About 0.7 cubic foot of air can be considered as not taking part in the combustion, consequently only about 77 per cent. of the air charge can be utilised. If, however, a higher pressure of, say, 450 lb. was employed the compression space would only hold 2 cubic feet and the volume of lost air remaining the same only 65 per cent. of the air charge would be available for combustion. Taking a normal mean effective pressure of 90 lb. per square inch on the top side of the cylinder, the bottom will give, therefore, 77 per cent. of this, or 69 lb. per square inch with low pressure and only 58 lb. per square inch with high pressure. It is true that the thermal efficiency is somewhat lower than with high compression, but the difference is not very great, and, considering that the overall efficiency of the double-acting engine is considerably higher than that of the single-acting engine, the total consumption of fuel per brake horse-power hour is lower than that of the latter. The friction losses, taking them as a percentage of the total indicated horse-power, are much lower, the absolute figure of friction horse-power being only slightly higher than that found on a single-acting engine.

As the bearing friction is an important factor in the total friction, it is instructive to compare the bearing pressures of different systems of engines. These pressures have been plotted out in Fig. 4 for two revolutions of a six-cylinder engine, taking into consideration the weight and inertia

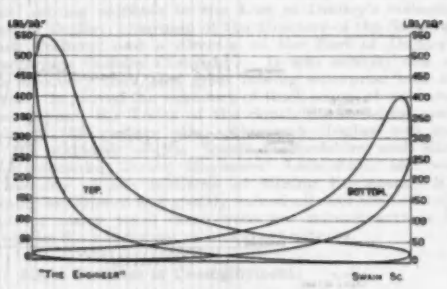


FIG. 2—TYPICAL INDICATOR CARDS

of the moving parts, and the mean of their absolute magnitude has been calculated in each case. The diagram shows that the total pressures on the eight bearings, taking the single-acting four-cycle to be 100, are as follows:—(1) Single-acting four-cycle, 100 with four reversals; (2) double-acting four-cycle, 104.5 with six reversals; (3) single-acting two-cycle, 126 with no reversals; (4) double-acting two-cycle, 86 with eight reversals. A reversal means that the pressure on the bearing is shifted from bottom brass to top brass and *vice versâ*, and the number of reversals plays, no doubt, a part in the lubrication of the journal, although the importance of a reversal is certainly far greater in a non-rotating bearing such as the crosshead. This diagram also shows that the difference of the bearing pressures of a single-acting and a double-acting engine is only about 4.5 per cent., and as the friction is directly proportional to the pressure, the same difference in friction losses can be expected. This, again, means that the indicated power of the bottom cylinder is almost entirely turned into effective power on the crank shaft.

Another advantage of the low compression and the low mean pressure on the bottom side of the cylinder is the lower maximum pressure—about 400 lb.—which is the determining factor for the dimensions of the moving parts,

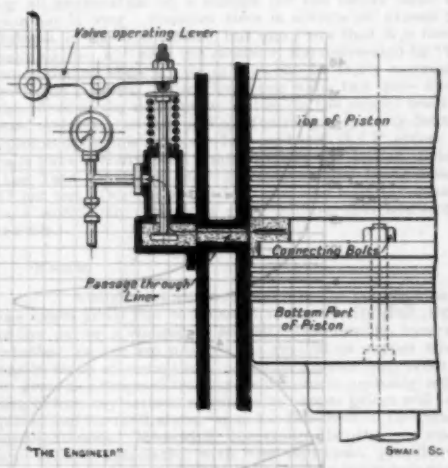


FIG. 3—PISTON LEAKAGE TESTING DEVICE

and a reduction of the piston-rod diameter means an increase in useful piston area.

One of the objections usually made against double-acting engines is the impossibility of watching the piston, as the cylinder is closed on both sides. In a four-cycle single-acting engine one can see immediately when the piston rings get gummed up, because the piston starts to leak, which can be heard and seen. One can then take measures against it, and, if necessary, shift the rings at the first opportunity. In a double-acting engine, however, a leak can neither be seen nor heard.

A very simple means of detecting a leak of the piston has been adopted—see Fig. 3—which is so sensitive that even the tendency to leak can be detected, and at the same time the condition of the cylinder lubricating oil can be ascertained. The piston consists of two parts, the upper and lower, which are fixed by bolts on the piston-rod flange. In both parts a number of piston rings are placed, leaving an open space in the middle between the upper and the lower group of rings. If the rings are leaking—in general this can only be expected from the top rings—the pressure in this open space rises. In the cylinder liner is a small opening connected to a valve, which is opened up by a cam on the cam shaft every time the piston passes it after a

* Institution of Naval Architects. Summary.

combustion on the top. From the valve a pipe leads to a gauge, which indicates the pressure. This pressure should be constant, and a rise clearly indicates that something is wrong with the rings. A cock in this pipe allows a sample of the lubricating oil to be obtained.

The power developed by this new type of engine is about 80 per cent. more than that given by a single-acting engine of the same size. Taking into consideration that the piston speed can be made 15 per cent. or 20 per cent. more than that usual in two-cycle engines, and that no power is needed for scavenging purposes, this engine actually develops about the same power as a single-acting two-cycle engine of equal size, with less heat stress on covers and liners. The lubricating oil consumption is not greater than for a single-acting four-cycle engine of the same bore, and power for power it will be roughly one-half.

The experimental engine fuel valves are fitted with air injection, both the top and bottom. Arrangements have been made, however, for the use of solid injection in both ends of the engine cylinder. In particular the bottom of the cylinder presents perfect conditions for solid injection, the shape of the combustion chamber and the shape of the diagram which it is desired to obtain lending themselves particularly well for its adoption.

The system of solid injection which is being used is that put forward by Professor Arschaouloff, and the following is a brief description of it. The high-pressure fuel pump shown in Fig. 6 is driven by a small impulse piston, the impulse cylinder being in open communication with the main working cylinder. The ratio between the areas of the impulse piston and the fuel pump plunger determines the pressure of the fuel in the pump. Thus if the compression is 370 lb. and this ratio 1 : 13, the fuel pressure would be 4800 lb. A spring-loaded spindle valve of the differential type is opened automatically when the compression in the fuel pump has risen to a certain figure, and the fuel enters the cylinder. The pressure rises when the injected fuel burns, and causes new fuel to enter with increased pressure. The diagrams reproduced in Fig. 5 show a normal card, a displaced card, and a card taken simultaneously of the travel of the impulse piston. This impulse piston starts to come down at the point (*a*) when the differential valve is opened. The rise in pressure in the cylinder does not take place immediately; on the contrary, a drop in pressure can be noticed, partly due to the compression space being increased in volume because of the impulse piston coming down, and partly to the cooling effect of the entering fuel being vaporised. At point (*b*) the fuel suddenly flashes off. The time lag can be determined on the crank circle, and the figures found fit in exactly with the experimental results published by Commander Hawkes in his paper on "Some Experiments in Connection with the Injection and Combustion of Fuel Oil in Diesel Engines," read before the North-East Coast Institution of Engineers and Shipbuilders. At point (*c*) all the fuel has been injected into the cylinder and the spindle valve closes.

These diagrams give a clear insight into the process of combustion. The amount of fuel injected can be easily computed at any moment, and the corresponding rise of pressure seen on the diagram. It is interesting to note that about 42 per cent. of the fuel is introduced before the dead centre.

A drawing included in the paper shows a comparison between an eight-cylinder single-acting engine and a six-cylinder double-acting engine of equal power. The proposed six-cylinder double-acting engine is about 20 per cent. lighter; the engine-room would be 12ft. shorter; the fuel consumption will be lower, and the lubricating oil consumption considerably less. In the case of a twin-screw vessel fitted with single-acting engines their substitution by a single-screw double-acting engine shows, therefore, a very marked simplification in every direction.

In conclusion the authors state that they quite realise that from a theoretical point of view their solution of the problem of the double-acting engine can be considered doubtful, if not wrong. It may seem, indeed, going the wrong way deliberately to abandon part of the air present in the cylinder and not use it to burn fuel with and to accept a low compression when obviously the thermal efficiency is better with a high compression. This, however, they regard as the academic side of the question, but on the practical side they want to have a reliable, simple, and accessible engine, even if the satisfaction of getting the highest possible mean pressure and the lowest attainable fuel consumption per indicated horse-power is denied. They are of opinion that this is a point which every engineer with sea experience will appreciate, and that the shipowner will not worry so much about thermal efficiency if he can keep the repair bills down and if the ship has no undue delays.

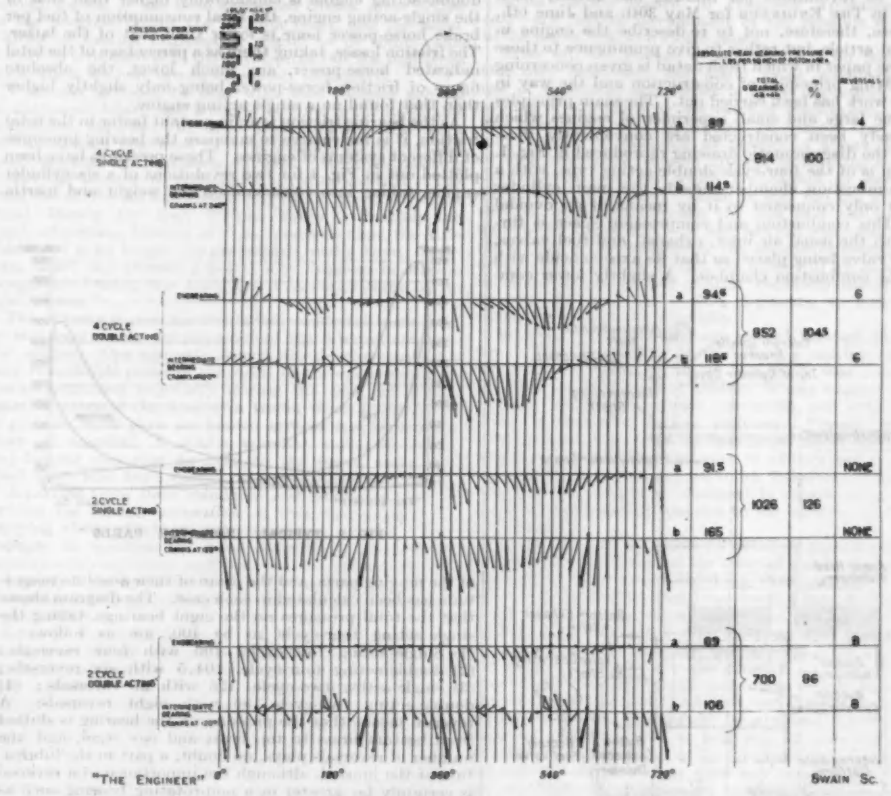


FIG. 4—DIAGRAM OF BEARING PRESSURES FOR DIFFERENT TYPES OF ENGINE

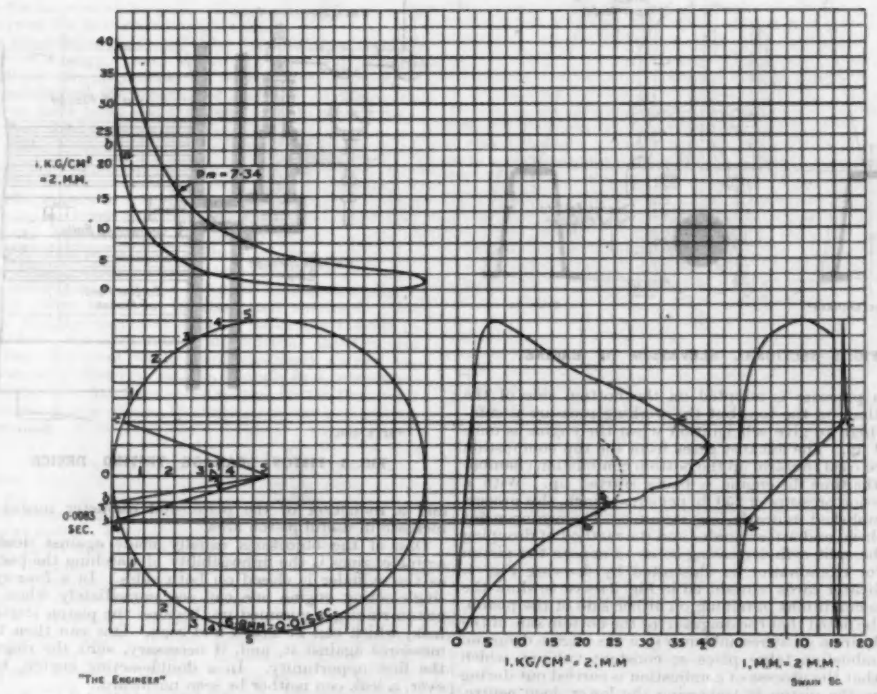


FIG. 5—TYPICAL DIAGRAMS OF ARSCHAOULOFF SYSTEM OF SOLID INJECTION

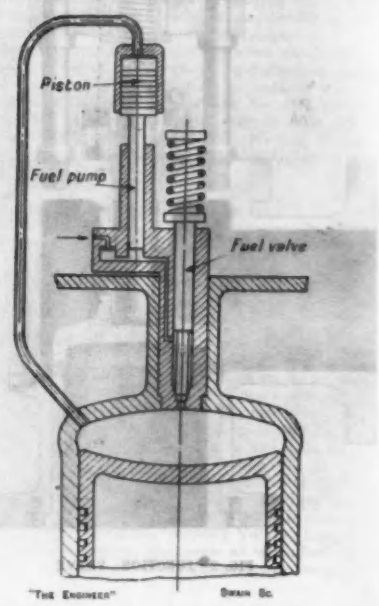


FIG. 6—SOLID INJECTION FUEL PUMP

THE INTERNATIONAL LIFEBOAT CONFERENCE.

THE International Conference on the World's Lifeboat Service, which was held in connection with the centenary of the Royal National Lifeboat Institution during the past week, proved to be an event of outstanding interest. Not only were the technical and administrative representatives of our British Institution present, but there were also delegates from lifeboat societies in Holland, America, France, Denmark, Sweden, Norway, Spain and Japan. Altogether, eight lifeboats, each of which had come to the Thames under its own sail or motor power, took part in the inspection of the boats by Admiral of the Fleet Sir Doveton Sturdee, Bart., G.C.B., and in the procession of boats up to Fulham. Other events included the presentation of the Institution's Gold Medals by his Majesty the King to seven lifeboat heroes and the centenary dinner of the Royal National Lifeboat Institution, at which the Prince of Wales, President of the Institution, presided. The Conference was held on Tuesday and Wednesday, July 1st and 2nd, in the Westminster City Hall, and after the presentation of addresses from the Swedish Ministry of Commerce and the Swedish Lifeboat Society, the following papers were read and discussed:—"Lifeboat Signals," by Captain H. F. J. Rowley, R.N., Chief Inspector of Lifeboats; "Self-righting and Non-self-righting Lifeboats," by Mr. J. R. Barnett, consulting naval architect to the Institution; "Sailing Lifeboats and Motor Lifeboats," by Mr. F. Rubie, surveyor of lifeboats; "Auxiliary and Full Power Motors on Lifeboats," by Captain Rowley, R.N.; "The Construction of Lifeboats," by Mr. J. R. Barnett; "Petrol and Heavy Oil Motors for Lifeboats," by Mr. Arthur F. Evans, surveyor of machinery; "Tractive Power or other Means for Launching Lifeboats over Flat Open Beaches," by Commander Stopford C. Douglas, R.N., Deputy Chief Inspector of Lifeboats; "An International Lifeboat Service," by Count Kozo Yoshii, President of the Imperial Japanese Lifeboat Institution; "Some Inside Aspects of the Lifeboat Service in Denmark," by Captain Yorgen Frederick Saxild, of the Marine Ministry, Denmark; "The Question of the Desirability of an International Distinguishing Mark for Lifeboats," by Mr. Ottar Vogt, secretary of the Norwegian Life-saving Society; "A Description of the Dutch Twin-screw Self-righting Motor Lifeboat Insulinde," by Mr. H. de Booy, secretary of the North and South Holland Life-saving Society; "The Value and Use of

Heavy Oil in Broken Water for Lifeboat Work," by Captain Rowley, R.N.; and "Line-throwing Appliances," by Commander Stopford C. Douglas, R.N. These papers have been printed in handy booklet form by the Royal National Lifeboat Institution.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Situation.

THE weekly meeting at Birmingham to-day—Thursday—of the Midland iron and steel trade, which was moderately attended, brought some little addition to the business in hand. Quiet conditions, however, continue in both the iron and steel departments, though slightly more interest is taken in forward requirements, a few orders for raw iron and steel having been placed for autumn delivery. This is not the time of the year when much initiative in business undertakings is expected. Industrialists are well content if trade has sufficient momentum to carry production forward till the autumn demand manifests itself.

The Coke Position.

Consumers hereabouts welcome the proposal for a chemical basis for coke supply contracts. Buyers have long complained that from some ovens they have not received value for their money—at least that has been the allegation. One thing has, however, always to be guarded against when buyers of any commodity are acting mainly upon the policy of getting something cheap, namely, that quality often suffers. In respect of coke perhaps more than almost any other blast-furnace commodity quality is a matter which should be watched, and it does not at all follow that the drop of 2s. per ton on the average of cokes used in the Midland furnaces, which is to begin to operate this month, will be all profit. Even with a promise of the reduction named there are still to be found discontented furnace owners, and these are refusing this week to renew contracts at the fresh 22s. a ton at ovens price. They declare they will not contract forward at above 20s., and they are hoping that the end to the present, at any rate, of the shipping coke boom will play their game and enable them to buy at the price just put down.

Raw Iron.

Pig iron prices continue to fall, and for most descriptions concessions can be obtained. Though demand is generally poor a few large buyers have this week placed tonnages for autumn delivery. The end of the quarter is usually a quiet period, and it is thought just possible that a buying movement may follow the quarterly meeting a week hence. Smelters are anxious to carry on as long as they can see any outlet for their production, but the position of furnaces which have no auxiliaries is precarious. One firm in Northampton has been compelled to extinguish a furnace, and a second is likely to be put out of action this month if demand does not improve. On 'Change in Birmingham to-day—Thursday—prices gave way further, and it does not look as if pig iron will be left with any great share of the saving in the cost of coke. Derbyshire houses no longer adhered to the quotation of 94s. for No. 3 foundry. Some of them refused to drop more than a shilling, but supplies could be obtained from various sources at 92s. 6d. Northamptonshire prices relapsed to 87s. 6d. for No. 3. There was scarcely any inquiry for forge qualities. The small amount of business being offered could only be taken by making further concessions. A general complaint is that users of forge iron, especially in South Staffordshire, are declining to take deliveries of iron contracted for. The coke situation is somewhat more favourable to the maker of pig iron. Prices are easier than for many months, and a change still better appreciated is the reversion to the old system of charging according to quality. The users of coke are still pressing for lower prices, and as this fuel is now fairly abundant substantial reductions are looked for. Northamptonshire furnaces are very bad'y off for orders. Derbyshire smelters have in many cases a closer alliance with the foundries and are not quite so badly hit. The pipe trade is a valuable resource to them, and the activity which now prevails in that department is helping blast-furnaces to keep going. Further accumulations of stocks of pig iron cause disquiet, however, in view of the downward tendency of prices and the improbability of a rally.

Steel.

The steel trade has now nearly exhausted the large orders placed some time ago, and is wanting work. Current requirements are fairly large but insufficient for the greatly augmented plant laid down since the war. Orders are difficult to get, competition being extremely severe. While there are a fair number of constructional engineering undertakings being negotiated, as a rule they do not represent large steel tonnages. Steel prices in most departments are weak in spite of the fact that there has been a stiffening tendency in the price of continental material. Steel makers have reviewed the position, but no conclusion concerning price revision has been arrived at. Considerable latitude is essential in existing circumstances. Owing to the rate of exchange Belgian steel quotations continue to undercut native prices, recent offers giving an advantage to the buyer of finished steel of at least £1 10s. per ton compared with native steel. One large sheet roller is said to have stopped a number of his steel furnaces, finding that he can buy his semi-finished sheet bars much more cheaply from Belgium. In such lines as weldless tubes, Germany has undercut native manufacturers lately by as much as £10 per ton. The heavy deliveries of billets from the Continent have overstocked a number of Black Country works. Consumers are proposing to demand a time limit in future, to prevent this dumping in large quantities of long overdue material. Belgian billets have hardened 2s. per ton, being quoted this week £7 per ton. Native billets are still obtainable at £7 12s. 6d. to £7 15s. per ton.

Scrap.

Steel scrap is a weak market, recent sales being at £4 2s. 6d., delivered in the Midlands, a further reduction of 2s. 6d. per ton. Wrought iron scrap continues to be called for in fair quantities and late values are upheld.

Staffordshire Iron.

In the Staffordshire finished iron trade activity continues to be almost wholly restricted to best bars, which are called for in good quantities, notwithstanding the price of £15 per ton. Merchant iron, which costs £3 more than steel, is increasingly neglected for the cheaper material, though occasionally products, even of the highest price, are called for by such countries as America in spite of tariff obstacles. Crown bars are still quoted £13. Beset by Belgian competition, common bar mills are doing very little, hampered as they are by excessive produ tion costs. Belgian No. 3 iron can be bought at £8 5s., against the Staffordshire price for nut and bolt iron of £12. The strain is being felt severely in the iron trade, and the works of J. and C. Holcroft, Limited, of Tipton, South Staffordshire, have now been added to the number closed down, the stoppage being for an indefinite period. This concern has operated continuously for well over a century. Staffordshire works are for the most part re-rolling steel mainly of Belgian origin.

Galvanised Sheets.

The galvanised sheet trade is still meeting with an active demand, works being busy with good forward business. Manufacturers continue to get £18 5s. and upwards for galvanised corrugated sheets of 24-gauge. The tin-plate trade is also fairly lively; one order recently booked was for 150,000 boxes and was booked against American competition.

Iron and Steel Prospects.

"Watchman what of the night?" is a vision constantly engaging Midland iron and steel masters. It is with much zest consequently that the pronouncement since my last of Mr. Edward Steer, chairman of Guest, Keen and Nettlefolds, on trade prospects has been studied. Conditions are pronounced by Mr. Steer still so unstable that he declined to attempt a forecast of this year. For his own firm, however, he declares that they mean to hold their own in those export markets where the Customs preferences accorded to native manufactures do not preclude the possibility of successful British trading. Respecting Colonial business, the preferences afforded British trade are welcome as helping to shelter and sustain it. Mr. Steer can only suggest lower costs of production as the means to combat present iron and steel European competition. He contrasts as inimical to Midland iron and steel masters the 60 hours per week worked by German ironworkers, with the 48 hours in this country. While, too, German wages in the iron and steel mills are considerably less than pre-war, ours are still much over that standard.

Constructive Engineering.

"It is practically impossible to secure work at a profit, and present anxiety is how to keep down losses." These words were uttered a few days ago by the chairman of one of the leading constructive engineering works in the Black Country, a concern which has been established now nearly half a century. Last year the proportion of the total output of the works exported was not above 27 per cent., which compares with 60 per cent., the firm's proportion in 1914. Much of this diminished trade is attributed to the current financial condition of the Colonies, "which will not allow of their carrying out the much-needed improvement and extension schemes which many of them desire to undertake." The constructive engineering concern I have in view and other similar heavy Black Country firms are just now powerfully repeating earlier appeals to the railway carriers to reduce rates on work for export. They point out that, compared with firms on the coast, Black Country constructional concerns are at the outset 16s. per ton worse off, since this is to-day's cost of carriage of ordinary steel work to the nearest shipping ports.

Engineering.

In the Midlands heavy engineering industry a certain amount of price cutting is in evidence just now, the fight for orders being extremely keen. Business generally is far from bright. Working hours have been curtailed in many branches, while in other cases manufacturers are taking the risk of making for stock. Pumping engineers in the Black Country are maintaining a level of trade and, if anything, business for some months has shown a very slight upward tendency. Motor engineering establishments are well employed. In the Birmingham district there are engineering establishments that have maintained steady activity for a long time past, side by side with others that are running on short time with a reduced *personnel*. It is a hopeful augury that the machine tool trade is showing rather more life. One well-known local firm is restarting its foundry after two years of enforced idleness. But the demand for machine tools is very patchy.

British Works in Australia.

British screw manufacturers, of whom there is a small select number outside Nettlefolds, Limited, are curious regarding the steps Nettlefolds are taking for establishing a new screw industry in Australia. Mr. Tom S. Peacock, Nettlefold's managing director, is now back in England from his six months' visit "down under," and he has brought back with him all the details for establishing a screw factory in Australia to serve Nettlefold's Australian and New Zealand trade. The directors seem to have every confidence that the new works will be a success, and between now and the next twelve months a good deal will have been done to erect and equip the factory ready for operations.

Cannock Chase Miners' Wages.

The wages of miners working in the Cannock Chase coalfields are to be advanced this month, the ascertainment for July showing a percentage on the 1914 basis of 79.83 against 77.44 for May and June. The difference in the pay for the various grades of men and lads engaged in the industry ranges from 1d. to 3d. per shift. Under the new rates firemen will receive 15s. per shift, examiners 13s. 11d., stallmen 11s. 10d. (minimum), loaders 9s. 11d., datal'ers 9s. 7d.

Death of a Noted Mining Engineer.

On Saturday last the death took place of a prominent Midland mining engineer in the person of Alderman John Hughes, of Priory Farm House, Dudley. Mr. Hughes, who for the past sixty years had been prominently associated with the mining industry, was chief mining engineer to the Earl of Dudley's collieries west of Dudley, chairman of the directors of the Sandwell Park Colliery, and a director of the Earl of Dudley's Baggeridge Colliery Company. It was entirely due to his discovery that this great mining enterprise had its birth. It proved the existence of thick seams of workable coal beyond the limits of the South Staffordshire coalfield on the western side. Alderman Hughes was one of the founders of the South Staffordshire and East Worcestershire Mining Engineers' Association, and was a member of the Institute of Mining Engineers. His mining experience was greatly valued all over the country, and for many years there were few mining actions in which he did not appear as an expert witness.

Slight Decrease in Unemployment.

The latest returns show a slight decrease in the number unemployed in the Midlands, the total figure being 129,392, as compared with 130,338 for the period ended June 16th. Up to a week ago there had been a increase in the figures of 11,083 since the beginning of the month, but the current total shows a decrease of 946. The latest figure is made up of 96,567 men, 2112 boys, 28,110 women, 2603 girls. The returns for some of the principal centres are:—Birmingham area, 29,958; Bilston, 3141; Coventry, 2820; Cradley Heath, 4630; Dudley, 3955; Oldbury, 1630; Smethwick, 4188; Stourbridge and Brierley Hill, 3432; Walsall, 5654; West Bromwich, 2975; Wolverhampton, 5683; Worcester, 1539; and Tipton, 2227.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Conditions.

THE markets for iron and steel remain in a comatose condition, and non-ferrous metals are not much better here, although in London there seems to have been more life. As for iron and steel, people here seem to have given up all expectation of a change for the better until the summer is over. Summer time is always an excuse for dulness in the iron trade; but one fears that it is now a mere excuse, and that the causes of the depression lie very much deeper than anything that can be fairly associated with the seasons. There has been some talk here about the effect of the new Indian duties on the export trade in steel and iron, but it is perhaps too early to get any definite opinion upon this matter. It is said that G.I.P. orders for rails have already been transferred to the Indian makers (the Tata Company), the protective duty being nearly £1 per ton. Our export trade in iron and steel is certainly in a sufficiently dangerous state without this additional trouble.

Metals.

A slight return of firmness in the copper market has again given rise to hopes that the deadly dull period of low prices is coming to an end. One doubts, however, whether we are yet near to the revival in copper which has to come at some time. A much greater improvement in general European trading conditions is probably requisite before any serious advances in copper prices will take place, and we need a year or so for this even in favourable circumstances. Meanwhile the trade disturbances which are always associated with the American presidential election may be expected to prevent any improvement in the American consumption of copper. Some people place faith in the revival of the German demand as a consequence of the better chances of settlement of the reparations problem; but this, again, will take time to develop. The local demand for ingot copper here is only small, and the prices asked by merchants are about what they were last week. At the moment the low price of copper is the principal thing to be said in favour of the market. There is certainly not much risk of a fall even if there be no present probability of a rise, and those manufacturers who have contracts involving the use of copper next year might consider the advisability of covering their requirements. In the scrap metal trade dulness still prevails, and dealers will buy only at low prices. Some of them offer only £44 per ton for gun-metal scrap; others £45 to £46, and £37 to £38 per ton for heavy yellow brass scrap. As the lowest price for brass ingots (60-40 composition) is £52 per ton, there ought to be a good demand for this cheap brass scrap, for its composition can scarcely be lower than 60-40. Tin has been rather steadier of late, and apparently it is waiting for something to turn up. The present price, although some £25 above the lowest point reached during the last fall, is not extravagantly high, and a sharp revival of buying might bring about a considerable rise. The "something" which is waited for is no doubt a return of America, and it is very difficult to say how long the American

consumer will be able to keep out of the market. The first sign of buying in that quarter would at once give a fillip to the market here. Lead has been fairly steady for a time, but the general belief is that prices are still too high. There is still a shortage of prompt lead, and this keeps the price up for immediate delivery; but larger arrivals are expected within the next month or so. The position in spelter seems to be a little more favourable than it was. There is not too much spot metal about, and the prices are moderate. At the same time the actual demand from the galvanising trades is rather poor.

Pig Iron.

The markets in Lancashire for pig iron are still inclined to sag, but there is as yet no rapid movement downwards, and this can scarcely come until costs are lower. As has been said before, costs alone cannot sustain a market in the absence of demand, but they can certainly delay the downward movement and render it very slow. Consumers of foundry iron here seem fairly well convinced that there is no need for any hurry in buying for the requirements of the next six months, and trade in Manchester is still quite a retail affair. The weakness in Cleveland iron seems to be caused mainly by the small demand for export. There is a fair demand for the home trade, but this is not nearly enough to keep the furnaces clear of accumulations, and there is now no system of making "warrants," which used to be such a help to furnaces during a dull selling time. Makers, of course, claim that their industry is better off without the warrant stores, and there would seem to be no chance of a restoration of this feature of the iron trade; but its disappearance is to be regretted from some points of view. In Manchester it is expected that Cleveland No. 3 iron will soon be available at 100s. per ton or even less, and hence buyers are not disposed to make contracts for Derbyshire or other Midland iron at more than 100s. delivered in this neighbourhood. One cannot say that they expect the price to come down to 95s. delivered, but there are some who do not think this to be quite impossible during the course of the year. Of course, in this case furnace coke must be cheaper, but there is no doubt that the fuel market is now very much weaker than it was. In Lancashire, during the anxiety caused some time ago by the threat of a coal strike, furnace coke sold at 33s. The other day it was offered at 25s. If one could have an equal fall in Midland coke, then Midland pig iron could be delivered here at 95s. per ton. The demand for forge pig iron is slackening and the prices are inclined to weaken. Scotch pig iron is also weak, but there is a threat to blow out some of the furnaces in Scotland if the present prices cannot be maintained.

Steel.

The extreme dulness in the markets for manufactured steel is not relieved and business here is very much restricted. Selling agents still quote £9 10s. for joists and angles and £10 2s. 6d. for common plates, but these are nominal prices and no doubt concessions would be made. At any rate, at the works £8 7s. 6d. is taken for any export business that can be got, and perhaps £8 5s., whereas the price was at £8 10s. when the figure of £9 10s. was fixed for Manchester delivery.

Scrap.

Dealers here in scrap iron and steel are rather depressed by the difficulty of selling sufficient to keep their stocks down. Scrap is always coming in, whether it can be sold or not, and this is particularly the case with cast scrap. The ironfoundries are using only a very moderate quantity of this, although the prices are favourable enough, ranging as they do from 87s. 6d. to 92s. 6d. according to quality. In buying, of course, dealers have now to allow for a margin of depreciation, because it is feared that any further fall in foundry pig will weaken scrap prices again. Wrought scrap is much as it was, and there is still a moderate demand; but there is very little call for melting steel scrap.

BARROW-IN-FURNESS.

Hematite.

The hematite pig iron trade is not showing much life. There is little margin between the production and the local consumption and general sale, but that is due to the fact that the steel works are taking a pretty heavy share at the moment. The general home trade in mixed Bessemer numbers is weak, and customers in Scotland, Midlands and South Wales are restricting their orders to immediate requirements. There are numerous inquiries, but there seems to be a general desire on the part of buyers to get prices down a little, a possibility which is very remote indeed. The overseas trade is not of much account, and as long as the rate of exchange keeps where it is there is not much chance of trade with the Continent improving. In the whole of the district there are twelve furnaces in blast, excluding, of course, the charcoal furnace at Backbarrow, which is still engaged and is experiencing a moderately good demand for its products. Failing an early improvement in the iron trade, it is possible, if the steel works cannot carry on, that there will be a restriction of output. Makers have no desire to accumulate stocks.

Iron Ore.

The iron ore trade is a little improved through more production, but none of the mines are doing very much. A better sign is the re-starting of the Hodbarrow mines and also Newton pit and Anticross, but the output is restricted to requirements at present. Business in Spanish and other ores is not brisk, nor is it likely to be until there is a general improvement.

Steel.

The steel trade is not very good and the works are mostly engaged on orders which have been held for some time. Fresh contracts are difficult to secure in view of keen competition. The rail mills at Workington will be idle for another fortnight yet. The Barrow mills are still engaged, but fresh orders are required if there is to be continuous running. The hoop and small sections mills are better circumstanced for business. Foundries are experiencing moderate business.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Steel Trade.

THE condition of the heavy steel trade of Sheffield continues unsatisfactory, especially on the basic side. The position is not easy to gauge accurately at present, as several of the works are shut down for stocktaking; but it is to be apprehended that when they resume operations it will be on a reduced scale. The decline in the placing of orders for open-hearth steel, which has been in progress since Easter, continues unchecked, and the position generally is considerably inferior to what it was last year at this time. The business that is on offer is very keenly competed for, and price cutting is reported, although the official quotations are hardly sufficient to cover costs of production. There is some ground for hope in the downward tendency of coal prices, which may assist iron and steel makers to bring down their costs and secure more business. It has long been recognised that one of the conditions most needed to enable the trade to recover prosperity is cheaper fuel. Another very desirable improvement would be a reduction in local rates, but this seems as far off as ever. At the annual meeting of William Cooke and Co., Limited, last week, the chairman pointed out that that firm was now paying, in Sheffield rates alone, exactly three times as much as it did in pre-war days.

The Railway Departments.

The situation on this side of the steel trade, which consumes large quantities of acid material, is less unsatisfactory than in the departments of which I have just been speaking. The plants manufacturing axles, tires, springs and buffers are fairly well supplied with work. Most of it comes from this country, and the chairman, at the annual meeting of John Brown and Co., last week, warmly acknowledged the public spirit of the home railway companies in placing the bulk of their orders in Great Britain at a time when they could buy the material much more cheaply on the Continent. The orders from overseas railway companies, however, are on a very limited scale, and the amount of work on hand in Sheffield, although considerable, is not sufficient to provide full employment for the plants. The activity of the cycle and motor trades is helping Sheffield to a considerable extent. The rolling mills, however, are quieter than they have been for a long period, except in the matter of sheets. The amount of business on their order books is small and few new orders are coming forward.

The Consett Iron Contract.

The position of the engineering trades is not satisfactory. Davy Brothers, Limited, who issued their report last week, showed a very much reduced profit. Sir William Ellis, who presided at the annual meeting, mentioned that they were more fortunate than some firms in having a moderate amount of work in progress, but added that the work had been taken at very low figures in the interests of the workmen, in order to find employment, and also in the firm's own interest, so as to keep the staff together and not to lose its prestige as one of the leading firms in the country in this class of industry. Orders were coming in to a moderate extent month by month. An important side of the company's trade consists in the provision of heavy engineering plant for steel works. As to this, Sir William remarked that with the steel trade so depressed as at present it was only natural that the firms should order as little new machinery as possible; but at the same time he pointed out that it was only those firms whose equipment was of the highest order who could hope to compete with prices such as were now ruling in the industry. Reference was made at the meeting to the important contract which the firm secured last year for the supply of new plate mill plants for the Consett Iron Company. That contract, which is probably the largest single one for rolling mill machinery ever placed in this country, is now about two-thirds completed. It represents a total sum of well over £200,000. It includes a 40in. electrically driven "Davy" slabbing mill with universal manipulator; 44in. by 12in. steam hydraulic slab shears, &c.; 32in. by by 6ft. 6in. electrically driven "Davy" three-high light plate mill with deflecting tables; 42in. by 9ft. 6in. electrically driven two-stand reversing heavy plate mill; and the whole of the handling equipment for the plate finishing department.

The Lighter Trades.

The hand tool trade is one of the busiest departments in the whole of the Sheffield industry. A brisk amount of business is reported in both the home market and in various export directions. The amount of trade being done with the Continent, while not large, is useful. Australia is a very good customer, but trade with Canada is not fully maintained owing to competition both from the Dominion itself and from the United States. For engineers' small tools there is only a moderate demand, but the tide in that trade is rising, and has been doing so for the last twelve months. This branch is now doing a little occasional business with Russia. In cutlery and plate there is not much change to report. The large-scale production of stainless table knives, as well as spoons and forks, is maintained, but the trade in best silverware and cutlery is not up to the average for this time of the year. The razor branch shows a little improvement. The demand for plate on export account has increased of late. Mr. C. J. Kavanagh, British Commercial Secretary at Cologne, who was in Sheffield last week, had some encouraging things to say to local manufacturers with regard to the situation in Solingen, which is Germany's great rival to Sheffield in the cutlery trade. Solingen, he said, had had its day, and Sheffield manufacturers had an excellent opportunity of winning back markets lost to Germans in 1920. There were ample opportunities in Holland and Scandinavia, to quote only two examples at random, and Sheffield had always the advantage of her reputation, quality, and stability.

Shipbuilding Contracts.

The placing of the contracts for the hull and machinery of two new torpedo-boat destroyers is of interest to Sheffield, though not directly so. One of the orders has gone to Southampton and the other to Glasgow. It is quite possible, however, that other localities may benefit to the extent of supplying fittings, as well as in providing steel plates and armament, and in this case Sheffield will no doubt receive its share of the work. Another matter which Sheffield will regard as a source of probable work for the future is the decision of the Australian Government to build two cruisers. A point of interest on the shipbuilding side is the booking of an order by Cammell Laird and Co., Limited, of Sheffield and Birkenhead, for two steamers for Elders and Fyffes' passenger and fruit trade between the West Indies, Central America, and Europe.

NORTH OF ENGLAND.

(From our own Correspondent.)

A Dismal Trade Position.

IT is difficult to find the least ray of brightness in the trade situation in the North of England. Indeed, there appears to be a pronounced note of pessimism, and there does not seem to be much hope for an early improvement. The first half of the year has been a very "lean" one in practically every branch of industry, and particularly so in the iron and steel trade. At the beginning of the year there were chastened hopes of a limited revival, and with the gradual recovery of the continental exchanges manufacturers did find themselves in a position to compete successfully in European markets. But the collapse of the franc speedily put an end to an all too brief period of industrial activity, and now the position of the trade is actually worse than at any previous period of the year. It is nearly two years since there was a parallel to the prices now ruling, and whereas in August, 1922, there were only 30 blast-furnaces in operation on the North-East Coast there are now 44. But there is not one of these which is not operating at a loss at present prices, and it seems highly probable that a curtailment of output will be necessary before the trade emerges from the existing slump.

Iron and Steel Exports.

A striking illustration of the marked contraction in foreign trade is afforded in the June figures of the exports of pig iron, manufactured iron, and steel from the Cleveland district. As a matter of fact, the export trade is in even a worse plight than the figures indicate, for the June figures include a number of shipments made in completion of old contracts which have not been renewed. Merchants are finding it almost impossible to negotiate such renewals. They cannot, in fact, compete with cheaper French, Belgian, and even German iron, and the foreign trade has dwindled to almost negligible proportions. The total of 37,795 tons of pig iron shipped during June represents little more than half the total for May, when the pig iron shipments reached 64,212 tons. Less pig iron was sent to every destination in June than was dispatched in May, the chief customers being Italy, 5180 tons; Belgium, 6353 tons; Germany, 4215 tons; and France, 4419 tons. The manufactured iron and steel exports for June were the worst recorded since August of last year, totalling 47,982 tons, as compared with 71,082 tons in May. The imposition of the tariff caused a decline to 9000 tons in the exports to India, and there was an all-round contraction in the deliveries to other countries.

Cleveland Iron Trade.

The Cleveland pig iron trade presents no new features of moment. The fall in prices has brought in a little more inquiry from home and continental consumers, but buyers generally are still acting with the greatest caution, and business is very difficult to arrange. With the turn of the half year, however, hopes are entertained of some improvement. No. 3 G.M.B. Cleveland pig iron is now easily obtainable at 88s. per ton, No. 1 being 93s., No. 4 foundry 87s., and No. 4 forge 86s. Hematite mixed numbers are on sale at 96s. 6d. per ton, with some makers asking 97s.

Ironmaking Materials.

The foreign ore trade is lifeless. Only an occasional cargo changes hands, consumers being well bought, and any business done is on the basis of 23s. per ton c.i.f. Tees for best Rubio ore. The coke market is a little firmer, but 27s. 6d. per ton delivered at the works is still an average figure for good Durham furnace kinds.

Manufactured Iron and Steel.

Unsatisfactory conditions still prevail in the manufactured iron and steel trade. The demand is languishing, and makers are finding great difficulty in keeping their plant running. The market for galvanised corrugated sheets is still strong at £18 5s. per ton, and the works are well supplied with orders, but this is the only bright spot.

The Coal Trade.

A welcome improvement is recorded in the Northern coal trade. There has been a marked increase in the inquiry circulating for coals for July and the whole of the second half of the year, but generally the prices indicated by buyers are affected by the recent low figures, and offers named are even at lower figures than those generally circulated, so that business matures very slowly. The coal fitters for all classes endeavour to prevent prices from slumping below the recent average value, but at the same time are pressing contractors to take out full

quantities, and the latter are consequently forcing supplies on the market, and snap up what little positive business is obtainable at surprisingly low figures. During the past few days the contracts placed for over the next few months have been at cut prices on current values, and indicate that low values will rule over the period. There is no doubt that the Continent could absorb all available output, but cannot arrange to pay for it. Germany is buying very little just now, and the same remark applies to Russia, which was a good customer at this time last year. The coke market shows a steadier tone, and the pressure of gas coke is not so pronounced. Prices remain at the recent average.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

An improvement is noticeable in the production from Scottish shipyards, and recently the rate of output compared favourably with pre-war standards. The Clyde returns for the first six months of this year might almost be termed satisfactory, the figures being 118 vessels of 254,367 tons aggregate, against 58 vessels of 145,657 tons in the same period last year. During the month of June 21 vessels of 70,071 tons were launched. Included in that total, however, is the new motor liner Aorangi, of 20,000 tons, built by the Fairfield Company for the Union Steamship Company of New Zealand. Also included in the returns were the following:—Hector, twin-screw turbine, 11,400 tons, built by Scott's Shipbuilding and Engineering Company, Greenock, for Holt and Co., Liverpool; Atago Maru, twin-screw motor ship, 7500 tons, by Lithgows, Port-Glasgow, for the Nippon Yusen Kabushiki Kaisha, Tokio; and four steamers of between 5000 tons and 6000 tons. The outlook, however, is still very uncertain. Some of the contracts in the course of completion are now subjected to higher costs than were current at the time of placing, and builders may be faced with a loss instead of a small margin of profit. The placing of new contracts is also likely to be affected. A fair number of new orders have been reported, but hardly sufficient to make good the number of vessels launched. It has been said that the specialisation of certain firms in motor ship construction has brought out a number of orders, the absence of which from the statistics already given would have made a material difference to the industry. Motor ships also figure largely in the contracts placed during the month of June, the chief of which are as follows:—Scott's Shipbuilding and Engineering Company, Greenock, a motor ship of 6000 tons, for Holt, Liverpool; Barclay Curle, Whiteinch, a motor ship of 5000 tons for Harris and Dixon, London; the Blythswood Shipbuilding Company, Scotstoun, two twin-screw motor tankers of 13,000 tons each for Norwegian owners.

Pig Iron.

Dull conditions still characterise the pig iron market. Some small sales of hematite are reported, while Cleveland iron comes freely from England. Demands for foundry are also limited. Prices generally are tending to become easier. Despite restricted outputs stocks continue to accumulate, and there is still some talk of reducing the production still farther.

Steel and Iron.

Reports from the steel works contain little of a fresh nature. Plate specifications are difficult to obtain, and the production of sections is below normal. Light sheets are busy, especially on export account. Black sheets are also busy, but chief interest centres in the galvanised descriptions, which are in strong demand for South Africa, India, and South America. Prices of corrugated sheets are firmer. Bar iron makers have only occasional good lines, and re-rolled steel has been somewhat disappointing. The demand for scrap material is irregular and comparatively small. Inquiries for steel rails and fish-plates on behalf of a home railway are reported.

Coal.

The dearth of new business remains the outstanding feature in the coal market. Inquiries are coming through, but negotiations seldom get beyond that stage. Prices are so irregular that prompt business is still cut to the lowest dimensions, buyers being confident that lower values will soon be forthcoming. Continental requirements are small, and the Baltic trade has been below expectations. Ayrshire fuels have been fairly well absorbed by coaling stations; but Lanarkshire coals are not moving freely. Certain descriptions of Fifeshire fuels have a fairly ready sale, but the Lothians are not too well supported. Generally speaking, idle time is prominent. Aggregate shipments for the week amounted to 266,915 tons, against 232,958 tons in the preceding week and 330,911 tons in the same week last year. The home market is stagnant. Prices are most irregular and can easily be shaded for a good order.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

On the whole there is not a great deal of change in the coal trade as compared with a week ago. It cannot be said that the general foreign inquiry has improved to any appreciable degree, and in this respect the conditions are very dull. There is one inquiry from the Algerian State Railways for 54,000 tons of patent fuel, or alternatively part of this quantity of locomotive coals for delivery at various Algerian ports during the last five months of this year. Tenders for this business have to go in towards the end of this month. Apart from this there is no special feature, and what business is available is confined to an occasional single cargo, for which, as may be expected, the competition is very keen. The docks position is by no means satisfactory, inasmuch as the week was started with nearly nine idle loading berths, but as a certain amount of tonnage was due to arrive, it was hoped that the loading pressure would improve. At the same time it is questionable whether chartering has been on a sufficiently active scale to warrant the expectation that shipments can really become good, and judging from the fact that many collieries are in need of fairly prompt orders, it looks as if the demand is below normal. There is one point about the market, and that is that superior Admiralty large coals are well stemmed for July shipment, and that prices have lately moved up, but in all departments the tone is barely steady.

Miners' Resolutions.

The annual conference of the South Wales Miners' Federation was continued to the end of last week, and the delegates fully maintained their reputation for passing interesting resolutions, whether they are practicable in the industry being quite another matter. Resolutions were passed that they should press for a six-hour day for all workmen in and about the mines, and until that was achieved their executive council was instructed to endeavour to secure a seven-hour shift for all men; further, that in future the starting time at all collieries throughout South Wales is to be 8 a.m. It was agreed that they should press for two weeks' holidays with pay each year for all mine workers, that firemen should be paid by the State, but that they should be appointed by the workmen, while the fact that the miners have in view a vigorous campaign against the non-unionist was supported by the resolution that the coalowners should be again approached in order to revive the non-unionist agreement and, if necessary, they should use drastic action to enforce this measure; also that South Wales should take action against non-unionists and members of the General Workers' Union and craft unions working in and about mines. In the case of income tax the conference decided to urge upon the Government to abolish all tax on wages; failing this, that travelling allowances, &c., be granted to all who may be called upon to pay a tax on wages. The question of stone-dusting in mines was referred to the executive council with instructions to obtain information from lodges. Instances were given in which the health of miners was alleged to have been undermined by the use of stone dust containing silica. The erection of pithead baths immediately was another matter discussed, and the executive committee was instructed to take all possible steps to press the Government and the coalowners on the question, while it was agreed to urge that the Summer Time Act should be abolished, and a resolution was passed that all colliery workmen on reaching sixty years of age should retire upon a pension of £2 per week, this to be borne by the State.

Miners' Wages.

The question of anomalies in the wages of classes of men at or near the level to which the lowest paid class of workmen shall be brought are to be dealt with by the owners in the district according to the new wages agreement, and the matter was dealt with at a meeting of the special joint committee of the owners' and workmen's representatives at Cardiff on Tuesday. The proceedings were naturally of a preliminary character, and it is understood that the consideration of the details, such as fixing the actual rates of wages for the grades of workmen referred to, including hauliers, traffic men and craftsmen, will be taken in hand immediately the agreement as finally drafted is signed. As regards the wages of miners in this district for the months of July and August, the rate will remain unaltered. The report of the joint auditors for the months of March and April, on the result of which the wage rate for this and next month are based, this shows that the proceeds of the industry were equivalent to 23.20 per cent. of the standard wages, or 24.75 of the 1915 standard wages. Adding 6.66 per cent. by which the standard wages exceed the 1915 standard wages, gives a total of 31.41 per cent. This is, however, below the minimum of 42.22 per cent. fixed under the new agreement, and, therefore, the miners' wages will be unaffected.

Dry Dock Workers.

The ship-repairing industry in this district continues to be somewhat quiet and orders are far from numerous. It was pointed out by the general manager at the annual meeting of the Cardiff Channel Dry Dock and Pontoon Company, held recently, that work on foreign vessels had declined to a tremendous extent, as the owners took their repairs to their home ports to avoid taxes by their Government on work done abroad. As about 60 per cent. of the vessels docking in the Bristol Channel were foreign owned the effect of this would be appreciated. Shipowners are also experiencing a very lean time, and this of course reacts on the repairing industry, as owners are compelled to only have repairs done which are absolutely necessary. As regards the wages question, which has been in evidence for several weeks past, although one section of the workmen has turned down the provisional agreement which was come to by the representatives of the workmen and the employers, hopes are entertained that the terms will be eventually accepted. It is thought that the men will see the wisdom of accepting a moderate advance in wages rather than fight for an increase which would handicap the industry as a whole and lead to a further diminution of work.

Current Business.

The demand for steam coals has been on a very moderate scale, and principally confined to the superior grades of Admiralty large, with the result that these particular coals are steadier. Best Admiralty large have actually been done as high as 29s. 6d., but whether this figure is likely to be maintained is a moot point. The fact remains, however, that these coals are very well stemmed for this month, and although other grades are very irregular, the improvement in the best descriptions may to some extent affect the demand for lower qualities. Small coals are rather more plentiful, though the better grades rule steady. Patent fuel is a somewhat quiet market, but anthracite coals have, if anything, a slightly better tone. Pitwood, though not heavily in supply, is still in excess of coalowners' requirements and values are about 25s. to 26s. per ton.

CATALOGUES.

Siemens Bros. and Co., Limited, Woolwich, S.E. 18.—Catalogue 170 on jointing materials; also catalogue 175 on chain type cable hooks.

Schneider et Cie., 28-32, Victoria-street, S.W. 1.—Catalogue issued by Chantiers et Ateliers de la Gironde dealing with the "Du Temple" boiler.

Ransomes, Sims and Jefferies, Limited, Orwell Works, Ipswich.—Catalogue on the Ransomes' "Orwell" electric industrial trucks (Mossay system).

James Keith and Blackman Company, Limited, 27, Farringdon-avenue, E.C. 4.—Pamphlet K97 on Keith mine fans; also pamphlet K129 on K-B drying plants.

Lambourne and Co., Limited, Victoria Steel Works, Manchester.—Brochure illustrating some of the contracts carried out by the firm in steel construction work.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The Victaulic Company, Limited, informs us that it has moved its offices from 28, Victoria-street, London, S.W. 1, to larger premises in King's Building, Dean Stanley-street, Westminster, S.W. 1.

At a meeting of the Council of the Royal Aeronautical Society, held on June 17th, Lieut.-Colonel H. T. Tizard, A.F.C., Fellow, was elected chairman for the year 1924–1925. Colonel Tizard will assume office on October 1st.

Samuelson and Co., Limited, of Britannia Works, Banbury, inform us that they have appointed Mr. Frank Carter, M.I. Mech. E., of 43, Parsonage Chambers, 3, The Parsonage, Manchester, as their representative in Lancashire, North Cheshire, and the West Riding of Yorkshire.

Wailes Dove Bitumastic, Limited, of 5, St. Nicholas-buildings, Newcastle-on-Tyne, asks us to announce that it has changed its London office from 5, East India-avenue to 1, Billiter-avenue, London, E.C. 3. Telegraphic address, "Bitumastic, Fen, London;" telephone, Avenue 174.

The Hoffmann Manufacturing Co., Limited, informs us that its Glasgow office has been removed from 62, Robertson-street, to 192, West George-street, Glasgow, C. 2. The new telephone number is "Douglas 3869," and the telegraphic address is, as before, "Hoffmann, Glasgow."

Millars' Timber and Trading Company, Limited, of Pinners' Hall, London, E.C. 2, announces that it has been decided to transfer the whole of its machinery business to a separate organisation specially adapted to deal with it, and that a new company has been registered for this purpose under the title of Millars' Machinery Company, Limited. The head office will remain at Pinners' Hall and the works at Kirtling-street, Battersea, S.W. 8.

Mr. H. I. Lewenz, M.I. Mech. E., M.I.E.E., who recently resigned his appointment with Vickers Limited, and Mr. J. W. Wilkinson, A.M.I.E.E., M.A. Min. E.E., late of 12, Tavistock-street, W.C., have joined forces as managing directors of a private company, to be known as Lewenz and Wilkinson, Limited, with offices at 25, Victoria-street, S.W. The new firm will be principally concerned with the application and supply of power plant and equipment for industrial purposes generally.

CONTRACTS.

Merryweather and Sons, Limited, of Greenwich, have again had charge of the fire-protection arrangements in the grounds of the Royal Agricultural Society's Show at Leicester.

Sir W. G. Armstrong, Whitworth and Co., Limited, have secured an order for thirty-seven heavy main line locomotives for the Bengal-Nagpur Railway. These locomotives are intended for goods traffic and are of the 2–8–0 superheater type, with six-wheeled tenders for a gauge of 5ft. 6in. They will weigh in working order about 113 tons. The contract has been secured in the face of very keen foreign competition.

Institution of Electrical Engineers.—The annual conversazione of the Institution of Electrical Engineers was held at the Natural History Museum, South Kensington, on the evening of Thursday, June 26th. It was attended by a numerous gathering of members and guests, who were received by the president, Dr. A. Russell, F.R.S., and Mrs. Russell. Throughout the evening the string band of the Royal Engineers played a selection of music in the Central Hall, and there was also an excellent vocal and instrumental concert in the Reptile Gallery. The evening was fine and the entertainment was in every way a success, the arrangements, as usual, being all that could be desired.

Weatherproof Iron.—We are informed that Samuel Osborn and Co., Limited, Sheffield, having found that there was a demand for a material which would resist the weather, have now produced a rustless material suitable for such articles as bolts and nuts and other fittings where the appearance does not matter much, but where a resistance to the weather is necessary. It is called "Weatherproof Iron," and is weather-resisting or weather-proof in the condition in which it is supplied; that is to say, no grinding or polishing is required to make it rustless. It is being used for steam valve spindles, as it has been found to resist superheated steam better than any material the firm has previously made. It is also particularly adaptable to the making of castings.

Recognition of Long Service.—We have received from W. and T. Avery, Limited, photographic reproductions of a diploma and silver badge which the firm awards to those of its workpeople who have been in its service for twenty-five years or over. Having completed that term the workers qualify for the diploma, which bears the wording: "An appreciation offered to ——— in recognition of ——— years of loyal and helpful association with the firm," and is framed in oak. The presentation is made by the managing director, who at the same time bestows on the recipient a small silver badge, to be worn in the buttonhole, which bears the words "Avery—Long Service." We are informed that the total number of recipients of this diploma up to date is 405, and that the aggregate number of years served by them is no less than 13,202—an average of some 32½ years each.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	17/6 to 24/–
(1) Spanish	23/–
(1) N. African	23/–
N.E. COAST—	
Native	—
Foreign (c.i.f.)	23/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 0 0	—
No. 1 Foundry	5 1 3	—
No. 3 Foundry	4 16 3	—
N.E. COAST—		
Hematite Mixed Nos.	4 16 6	4 16 6
No. 1	4 17 0	4 17 0
Cleveland—		
No. 1	4 14 0	4 14 0
Silicious Iron	4 14 0	4 14 0
No. 3 G.M.B.	4 8 0	4 8 0
No. 4 Foundry	4 7 0	4 7 0
No. 4 Forge	4 6 0	4 6 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 5 0	—
„ „ Foundry	4 13 6	—
(3) Northampton—		
Foundry No. 3	4 7 6 to 4 10 0	
„ Forge	4 0 0 to 4 3 0	
(3) Derbyshire—		
No. 3 Foundry	4 11 6 to 4 13 0	
Forge	4 5 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 14 6	—
No. 4 Forge	4 13 0	—
Basic	4 11 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 12 6 (a)	—
	5 17 6 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best „	—	—
N.E COAST—		
Common Bars	12 10 0	—
LANCS —		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	13 0 0	—
Best „	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	13 0 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	—
Gas Tube Strip	13 5 0 to 13 7 6	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	@
Ship Plates, ¾in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 3/16in. to ¼in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 5 0 to 18 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 5 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 5 0†	—
Light „	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
MANCHESTER—		
Bars (Round)	10 5 0 to 10 15 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
„ (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 15 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
MIDLANDS—		
Small Rolled Bars	10 0 0 to 10 10 0	
Billets and Sheet-bars	7 12 6 to 7 15 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 5 0	—
Angles	9 17 6 to 10 0 0	
Joists	9 17 6 to 10 0 0	
Tees	10 17 6 to 11 0 0	
Bridge and Tank Plates	10 10 0	—
Boiler Plates	14 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	22/7½ to 23/–
Block Tin (cash)	228 10 0
„ (three months)	229 2 6
Copper (cash)	61 12 6
„ (three months)	62 12 6
Spanish Lead (cash)	32 15 0
„ (three months)	30 2 6
Spelter (cash)	32 2 6
„ (three months)	31 17 6
MANCHESTER—	
Copper, Best Selected Ingots	67 0 0
„ Electrolytic	67 10 0
„ Strong Sheets	92 0 0
„ Tubes (Basis price)	0 1 1½
Brass Tubes (Basis price)	0 1 0
„ Condenser	0 1 2½
Lead, English	35 0 0
„ Foreign	34 0 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	10/6
„ 6 p.c. to 8 p.c. „	£23 10 0	8/–
„ 8 p.c. to 10 p.c. „	£23 0 0	8/–
„ Specially Refined		
„ Max. 2 p.c. carbon	£42 10 0	16/–
„ „ 1 p.c. „	£51 0 0	17/6
„ „ 0.75 p.c. carbon	£68 0 0	20/–
„ „ carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£17 for home, £17 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0	scale 5/– per unit
„ „ 75 p.c.	£18 10 0	scale 6/– per unit
„ Vanadium	19/3 per lb.	
„ Molybdenum	8/3 per lb.	
„ Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£135	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£120 to £130 (British Official).	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	17/3
„ „ Ell	19/–
„ „ Splint	20/– to 21/6
„ „ Trebles	19/–
„ „ Doubles	19/–
„ „ Singles	17/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	17/3
„ „ Splint	20/–
„ „ Trebles	19/–
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	17/– to 20/3
Screened Navigation	26/–
Trebles	20/6
Doubles	19/6
Singles	17/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	17/3
Secondary Steam	16/6
Trebles	19/3
Doubles	19/–
Singles	17/6

ENGLAND.

(3) N.W. COAST—	
Steams	30/–
Household	45/– to 58/4
Coke	33/6
NORTHUMBERLAND—	
Best Steams	19/6 to 20/–
Second Steams	19/–
Steam Smalls	11/6 to 12/6
Unscreened	16/– to 18/–
Household	27/–
DURHAM—	
Best Gas	23/– to 23/6
Second	19/6 to 20/6
Household	27/–
Foundry Coke	27/6 to 29/6

SHEFFIELD—	Inland.	
Best Hand-picked Branch	33/6 to 34/6	—
Barnsley Best Silkstone	27/6 to 28/6	—
Derbyshire Best Brights	27/6 to 29/6	—
„ „ House	24/6 to 26/6	—
„ „ Large Nuts	23/6 to 24/6	—
„ „ Small „	18/– to 20/–	—
Yorkshire Hards	22/6 to 23/6	—
Derbyshire „	21/– to 23/–	—
Rough Slacks	12/– to 13/–	—
Nutty „	11/6 to 12/6	—
Smalls	7/6 to 9/6	—
Blast-furnace Coke (Inland)*		
„ „ (Export)	f.o.b.	26/6 to 27/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	28/– to 29/–
Second „ „	27/– to 28/–
Best Dry Large	26/6 to 27/–
Ordinary Dry Large	25/– to 26/–
Best Black Vein Large	26/6 to 27/–
Western Valley „	26/– to 26/6
Best Eastern Valley Large	25/– to 26/–
Ordinary „ „	24/– to 25/–
Best Steam Smalls	18/– to 18/6
Ordinary „	16/6 to 18/–
Washed Nuts	25/– to 27/–
No. 3 Rhondda Large	28/– to 29/–
„ „ Smalls	22/6 to 23/–
No. 2 „ Large	24/– to 25/–
„ „ Through	20/– to 22/6
„ „ Smalls	15/– to 16/–
Coke (export)	50/– to 55/–
Patent Fuel	28/– to 29/6
Pitwood (ex ship)	25/– to 26/–
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	47/6 to 52/6
Seconds	42/6 to 45/–
Red Vein	28/– to 32/–
Machine-made Cobbles	57/6 to 62/6
Nuts	52/6 to 62/6
Beans	42/6 to 45/–
Peas	27/– to 28/–
Breaker Duff	10/– to 10/6
Rubbly Culm	15/– to 16/–
Steam Coals :	
Large	24/– to 26/–
Seconds	22/– to 24/–
Smalls	15/– to 19/–
Cargo Through	18/– to 22/–

(1) Delivered (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

Blast-furnace Coke (Inland): Special Price for Ironworks 23/–, open market 27/– (at ovens). † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

English Working Day.

A NUMBER of congresses have been held during the past week, and amongst them the Congress on Scientific Organisation appeals particularly to the French instinct for order and method, which has of late years exercised a considerable influence upon works' organisation. Many of the huge factories laid out since the war are models of efficient planning and management, although frequently at the cost of a subdivision of responsibilities and the creation of large and expensive staffs. Speaking generally, the results have proved remarkably satisfactory, and the annual Congress aims at perfecting this scientific organisation in the way of reducing production costs, which are steadily increasing with the inadequate supply of skilled labour. One of the matters discussed was the proposal to reduce the length of the mid-day intermission from an hour and a-half to an hour, as in England. The difficulty in the way of introducing this change lies in the fact that the French start the day with practically no meal, and as it is almost impossible to change national habits by law, the Congress came to the conclusion that there was nothing to be gained, and probably a great deal to be lost, by attempting to alter the existing order of things.

The Eight Hours' Day.

Even the eight hours' working day is failing to give the results that were expected of it at the time this measure was put into operation. The French adopted the eight hours' day with enthusiasm before it was certain that other countries would strictly follow the recommendations of the Washington Conference. Fortunately, the legislators left loopholes to enable manufacturers to employ their hands for a number of additional hours, according to circumstances, but even with these concessions, the effect of the law has been to rarefy skilled labour at a time when such labour is obtainable with difficulty. In the agricultural engineering industry, for example, it is argued that business cannot be carried on, so long as the eight hours' day is not general all over the Continent. The main reason for the agitation over the fewer working hours is the attitude of Germany, which has so far modified its labour legislation as to allow manufacturers in some industries to employ men for as many hours as they please. It is stated that in the mills and forges there are now two shifts of twelve hours each. The fear of German competition becoming accentuated by the increased number of working hours would suggest a confession of error on the part of those who got the Bill through by arguing that the men would produce in eight hours as much as they did previously in ten hours. It is evident that the eight hours' day will stand or fall according to the attitude of Germany. The International Labour Bureau at Geneva has decided to appeal to Germany to adhere to the recommendations of the Washington Conference, and if it fail to do so, it may be necessary to carry out modifications to the Bill in this country. The majority of the men would not object to work more than eight hours if they could earn more money by so doing. The visit of the British Minister of Labour to Paris to confer with his French colleague on this matter shows that the question is receiving serious consideration.

Reconstruction.

The labour question is also influenced to a certain extent by the state of things in the devastated regions, where operations have been almost entirely arrested by the impossibility of the Government to advance money for the carrying out of further reconstruction work. So long as there was a hope of the money being refunded by Germany, credits were given by the Government in the shape of negotiable certificates which were to be redeemed at certain dates; but as the German contribution to the cost of reconstruction has become a doubtful factor, the Government has ceased to issue certificates, and is unable even to redeem many of those already issued, with the result that the public works contractors have decided to suspend work until they are paid. This has released a considerable number of men, who might have been expected to supply all the labour that was needed elsewhere. The demand, however, is so great that the additional supply has been absorbed without having any appreciable effect upon the situation generally. It is true that there is much more building and other activity, and it is curious that the cessation of operations in the devastated regions has had no effect in reducing the phenomenally high cost of materials.

Grain Elevators.

The port of Dunkirk has been showing commendable enterprise during the past few years in completing its equipment with the most modern elevating and other plant. In the hope of competing with Antwerp for the traffic from Alsace-Lorraine and the north-east of France the Dunkirk Chamber of Commerce has spent considerable sums of money upon improving facilities for dealing with grain, coal and other commodities, and its enterprise is justified by the steady increase in the tonnage loaded and unloaded in the port. Dunkirk's hopes of becoming the chief port of transit for grain, coal and metallurgical products depend upon the carrying out of the scheme for connecting up the waterway system in the north of France, and, more particularly, upon a reduction of railway rates, for at present Antwerp seems to have an advantage, particularly so far as regards Alsace-Lorraine. The present increase in the tonnage handled, however, shows that Dunkirk is destined to grow in importance, and with the idea of facilitating the grain traffic, the Chamber of Commerce has constructed the largest and best equipped elevator in France. Started rather more than eighteen months ago, the elevator has just been completed and will be officially put into service this week. The grain is discharged by pneumatic shoots on to three transporters in an underground gallery, 280 m. long, and is carried up by four elevators, 41.50 m. high. The plant is capable of dealing with 4000 tons of grain a day, the whole being weighed and, if required, put in sacks.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

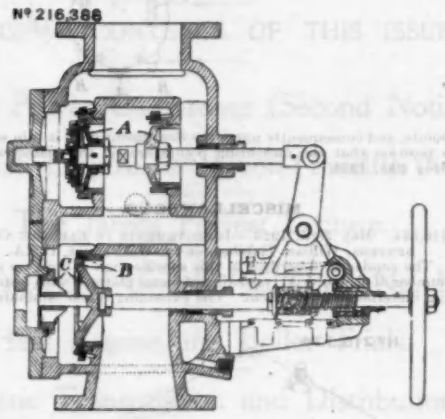
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TURBINE MACHINERY.

216,388. July 27th, 1923.—MANŒUVRING VALVES FOR STEAM TURBINES, Cockburns, Limited, D. Cockburn, and D. MacNicoll, Cardonald, near Glasgow.

This valve is intended for controlling the supply of steam to the astern turbines of marine installations, and aims at ensuring that no steam which may leak past the main valve shall find its

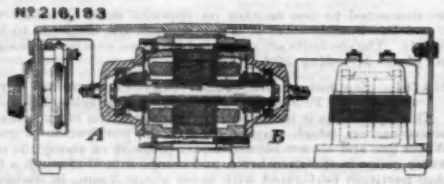


way into the turbine casing and spoil the vacuum there. The main valve A is thus succeeded by a secondary valve B, and between the two there is a "leak off" valve C, which leads any leakage steam to some convenient part of the power plant. When the valve A is shut, B also is shut, and C is open. When A is open, B is open, but C is shut.—*May 29th, 1924.*

DYNAMOS AND MOTORS.

216,193. February 20th, 1923.—IMPROVEMENTS IN DYNAMO-ELECTRIC MACHINES FOR THE TRANSFORMATION OF ELECTRICAL ENERGY, The M.L. Magneto Syndicate and Ernest Analey Watson, both of Victoria Works, West Orchard, Coventry, Warwickshire.

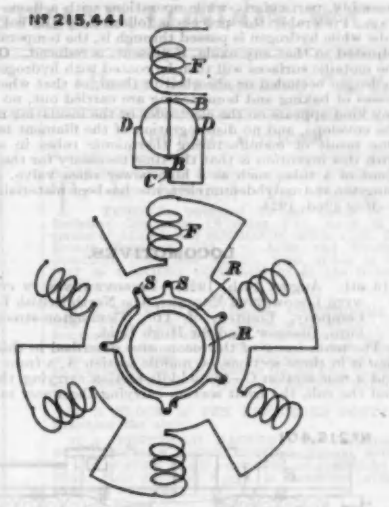
This invention relates to the transformation of electrical energy by means of small magneto electric machines, having permanent magnet excitation, and is intended for the purpose of facilitating the reception of wireless transmission. The invention consists in the employment of cobalt steel (or equivalent) permanent magnets having suitable pole pieces, in conjunction with a double-wound slotted armature core provided with two commutators A and B. One armature winding is wound to correspond with the voltage required for the valve filaments,



and the other for a voltage equal to, or in excess of, that required for the anode. Such a machine, when run as a motor off the battery which supplies current to the filaments, will furnish from its other pair of brushes a supply which, when passed through suitable smoothing circuits, may be applied to the anode or anodes of the valve or valves. The anode battery is thus eliminated. If the machine is driven by a separate electric motor from an electric supply system or source, the machine will furnish both filament and anode supply. In that case, no battery is required for wireless reception, either for the filament or anode. The machine will also act without a separate motor as a motor transformer, taking power from a direct-current supply system at its high voltage commutator, and delivering power from the other commutator for charging the filament battery or other storage battery.—*May 20th, 1924.*

215,441. February 8th, 1923.—IMPROVEMENTS IN ALTERNATING-CURRENT COMMUTATOR MOTORS, The Electro-Dynamic Construction Company and Nicolo Pensabene, both of 4, New Cross-road, S.E. 14.

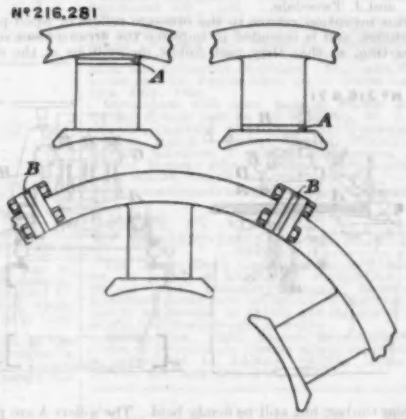
This invention relates to single-phase motors, having a shunt torque speed characteristic and fitted with two sets of brushes—main and exciting brushes—and the object of the invention is to improve commutation and starting torque and to make use of small commutators. In this type of motor, as shown in the upper diagram, one main stator winding is used and connected to the supply mains. The armature has a main set of brushes B B short circuited on themselves, and another set of exciting brushes D D, 90 electrical degrees apart from the former. F is the stator winding. The exciting brushes are connected in series with a compensating winding C, having an electro-motive force approximately in phase with the supply voltage for the purpose of increasing the angle of time phase between the two fluxes. The armature main brushes are thus made to supply a current, having a wattless component equal to, or larger than, the magnetising current required by the motor, thus making the primary current in phase or even leading with respect to the supply voltage. With brushes 90 electrical degrees apart, the motor will run near synchronous speed at all loads, and if the flux distribution along the air gap periphery is sinusoidal, the sparking voltage due to the combined transformer and rotation action on the coils short circuited by the brushes and undergoing commutation is nil. In practice, however, the shape of the flux density curve in the two axes is not sinusoidal. One can considerably differ from the other, owing to the distribution of the conductors in the stator and rotor. This is often the cause of sparking, and in practice it has been found that by moving the exciting brushes slightly out of their 90 electrical degrees position, the commutation can be greatly improved. A certain degree of speed variation can also be obtained by moving the exciting brushes within the limits imposed by a good commutation. In the case of a motor having a large number of poles, it is generally found necessary to use a large commutator in order to find room for the double sets of brushes. For the



purpose of avoiding such difficulty the inventors use two separate brush rockers which can be moved independently. One brush rocker carries a maximum number of main brushes equal to the number of poles minus two, while the other carries a minimum number of two exciting brushes. In the lower drawing a six-pole motor is shown, having four main brushes short-circuited on themselves and two auxiliary brushes in series with the compensating winding, as shown in the upper drawing. The brushes are not illustrated, but are carried by the brush rockers R R by means of rocker arms S S.—*May 8th, 1924.*

216,281. April 9th, 1923.—IMPROVEMENTS IN DYNAMO-ELECTRIC MACHINES, Jan Arthur Kuyser, of Knowle Lodge, Sibson-road, Sale, Chester, and the Metropolitan-Vickers Electrical Company, of 4, Central-buildings, Westminster.

The object of this invention is to provide improved means whereby in a direct-current exciter or generator constructed to provide a large variation of voltage stability at the lower voltages is maintained. With this object the magnetic circuit contains a relatively large quantity of material of low magnetic retentivity and a relatively small quantity of material of high magnetic reten-

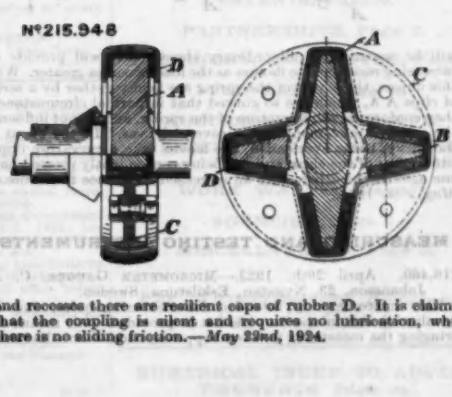


tivity in the form of plates which occupy the complete cross section of the magnetic circuit. For example, one or more hard steel plates may be inserted between a pole and its seat on the yoke or between a pole and pole face structure or in the body of a pole core, as shown at A in the upper illustration. Alternatively, the magnetic material of high retentivity may be inserted in the yoke, but when this disposition is adopted at least two plates B, one at each side of a pole, are necessary, owing to the division of the magnetic circuit at the junction of each pole with the yoke. In actual practice, it is desirable to insert a hard steel plate in each pole or between each pair of poles.—*May 29th, 1924.*

TRANSMISSION OF POWER.

215,948. May 1st, 1923.—FLEXIBLE COUPLINGS, The Daimler Company, Limited, and J. Dixon, Sandy-lane, Coventry.

This coupling comprises cross arms A and B, one on either shaft, which engage recesses in a loose ring C. Between the arms



and recesses there are resilient caps of rubber D. It is claimed that the coupling is silent and requires no lubrication, while there is no sliding friction.—*May 22nd, 1924.*

TELEGRAPHS AND TELEPHONES.

216,207. February 22nd, 1923.—IMPROVEMENTS IN AND RELATING TO THE MANUFACTURE OF VACUUM TUBES, AND PARTICULARLY OF THERMIONIC VACUUM TUBES, Claude Seymour, Henry George Hughes, and Thomas Edward Goldup, all of H.M. Signal School, Royal Naval Barracks, Portsmouth.

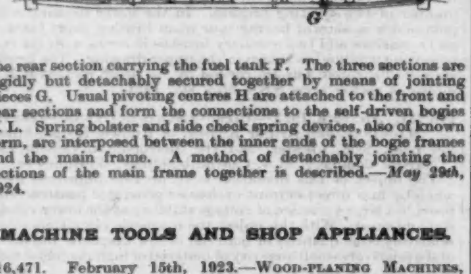
Vacuum tubes, and particularly thermionic valve tubes, are constructed in accordance with this invention by passing nitrogen or some other inert gas through the tube during the process of assembly, particularly while operations with a flame are under way. Preferably this process is followed by the baking of the tube while hydrogen is passed through it, the temperature being adjusted so that any oxide, if present, is reduced. On cooling, the metallic surfaces will then be coated with hydrogen, or have hydrogen occluded or absorbed in them, so that when the processes of baking and bombarding are carried out, no tarnish of any kind appears on the electrodes or the insulating material or the envelope, and no disintegration of the filament takes place. One result of manufacturing thermionic tubes in accordance with this invention is that the time necessary for the bombardment of a tube, such as a high-power silica valve, containing tungsten and molybdenum elements, has been materially reduced.—*May* 22nd, 1924.

LOCOMOTIVES.

216,401. August 10th, 1923.—IMPROVEMENTS IN CONNECTION WITH LOCOMOTIVE ENGINES, The North British Locomotive Company, Limited, of 110, Flemington-street, Springburn, Glasgow, and Sir Hugh Reid.

The main frame of the locomotive described in this specification is in three sections—a middle section A, a front section B, and a rear section C—the middle section carrying the boiler D and the cab, the front section carrying the water tank E, and

Nº 216,401



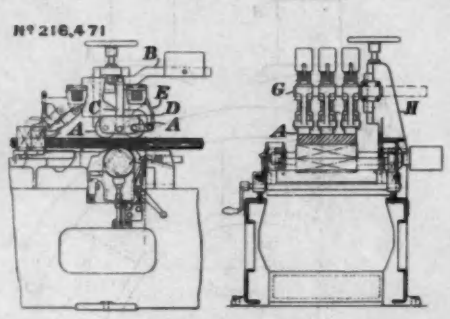
the rear section carrying the fuel tank F. The three sections are rigidly but detachably secured together by means of jointing pieces G. Usual pivoting centres H are attached to the front and rear sections and form the connections to the self-driven bogies K L. Spring bolster and side check spring devices, also of known form, are interposed between the inner ends of the bogie frames and the main frame. A method of detachably jointing the sections of the main frame together is described.—*May* 29*th*, 1924.

MACHINE TOOLS AND SHOP APPLIANCES.

216,471. February 15th, 1923.—WOOD-PLANING MACHINES, T. Robinson and Sons, Limited, Rochdale, C. J. Robinson and J. Tweedale.

This invention relates to the pressure rollers of wood-planing machines, and is intended to improve the arrangement of their mounting, so that they may follow inequalities in the surface

Nº 216,471



of the timber, but still be firmly held. The rollers A are pressed down on to the wood by the usual weighted lever B and links C, which are pivoted to the roller frame D. The frame is also connected with brackets E by means of links F, while the brackets are fixed on a bar G supported by the standard H.—*May* 15*th*, 1924.

MOTOR CARS AND ROAD TRAFFIC.

216,440. October 26th, 1923.—LAMINATED SPRINGS, E. Burnand, 73 *bis*, Avenue de Wagram, Paris.

In this invention the aim has been to produce a spring which

Nº 216,440

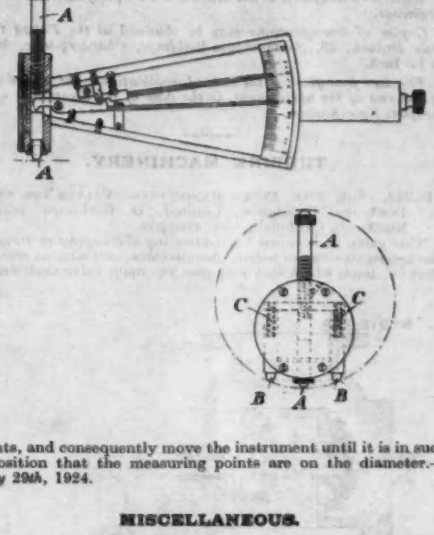
will be sensitive to all ordinary shocks, but will provide an increasing resistance to flexure as the load becomes greater. With this object, the leaves of the spring are held together by a series of clips A A, which are so curved that in normal circumstances they conform to the curvature of the spring, and do not influence the relative movement of the several leaves. In the event of the spring being overloaded, the leaves take a curvature opposite to that of the clips, and, by being consequently pressed hard one against the other, offer an increased resistance to flexure.—*May* 29*th*, 1924.

MEASURING AND TESTING INSTRUMENTS.

216,460. April 26th, 1923.—MICROMETER GAUGES, C. E. Johansson, 23, Nygatan, Eskilstuna, Sweden.

This micrometer is intended for measuring holes, and its peculiarity lies in the fact that it is provided with means for bringing the measuring points to opposite ends of one diameter. In the drawing, the measuring points are marked A A, and on either side of one of them there are two plungers B B. These plungers are pressed outward by springs C C, which are considerably stronger than the spring which actuates the measuring

Nº 216,460



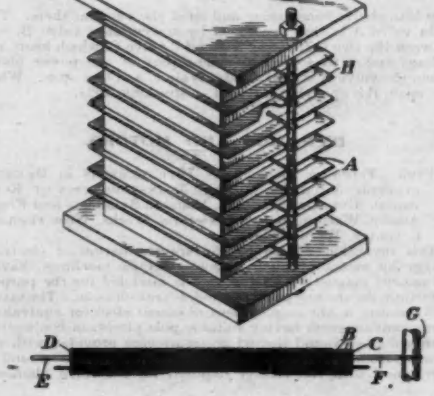
points, and consequently move the instrument until it is in such a position that the measuring points are on the diameter.—*May* 29*th*, 1924.

MISCELLANEOUS.

216,334. May 23rd, 1923.—IMPROVEMENTS IN ELECTRIC CONDENSERS, William Dubilier, of 48, West-street, U.S.A.

The condenser described in this specification is built up of a number of elements A, consisting of metal plates B with insulating material between them. The extending metal laminations

Nº 216,334

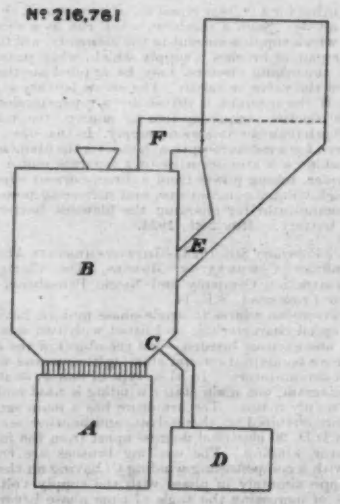


are connected to one another on opposite sides by solder caps C and D. Fusible wires E and F connect the elements to busbars G. The elements are separated from one another by insulating plates H.—*May* 29*th*, 1924.

216,761. September 17th, 1923.—MANUFACTURE OF ACTIVE CARBON, *J. Y. Johnson*, 47, *Lincoln's Inn-fields, London*.

This apparatus is intended for the production of exceedingly active carbon, which may be used in the purification of gases. Water gas and air are burned under pressure of about 150 mm. water gauge in the chamber A and escape into B through a fire-clay partition perforated with holes about 5 mm. in diameter.

Nº 216,761

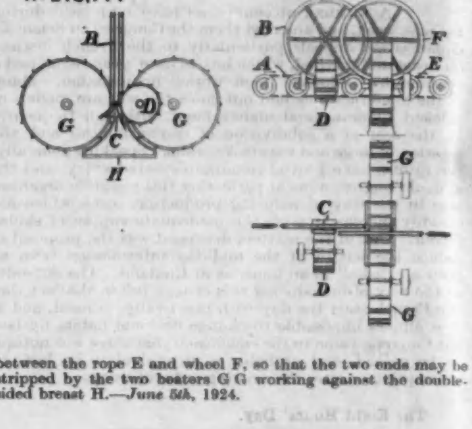


Above the partition there is a layer about 4 cm. thick of broken fire-clay, and on this there is the charge of peat charcoal. The charcoal is in grains of about 3 mm. size and the layer is 40 cm. thick. The charge is heated to 800 deg. Cent. and steam is then admitted to A. The waste flue F is closed, the outlet C opened, and the charge blown into D, which is filled with inert gas. E is the supply hopper.—*June* 5*th*, 1924.

216,777. October 23rd, 1923.—DECORTICATING MACHINES, H. J. Boeken, Salatiga, Java.

In this machine the leaves to be decorticated are looped over the rope A and are gripped between this rope and the wheel B while they are drawn between the breast piece C and beater wheel D. In this way the fibres in the centre of the leaf are freed of the fleshy material. The cleaned part of the leaf is then gripped

Nº 216,777



between the rope E and wheel F, so that the two ends may be stripped by the two beaters G G working against the double-sided breast H.—*June* 5*th*, 1924.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY TO SATURDAY, JULY 12TH.

WORLD POWER CONFERENCE.—At the British Empire Exhibition, Wembley. For programme see page 126.

TO-DAY AND SATURDAY, JULY 5TH.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.—Eighty-third Annual Show at Leicester.

SATURDAY, JULY 5TH.

THE INSTITUTION OF AERONAUTICAL ENGINEERS.—Visit to the Croydon Aerodrome at the invitation of Imperial Airways, Limited, at 3 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, London, S.W. 1. Joint meeting with the Institution of Civil Engineers. Draft Standard Test Code for Hydraulic Power Plants; drawn up by a Joint Committee of the Institutions of Civil and Mechanical Engineers. 11.30 a.m.

MONDAY, JULY 7TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Grand Hall, Connaught Rooms, Great Queen-street, London, W.C. 2. Institution dinner. 7.15 p.m.

MONDAY TO WEDNESDAY, JULY 7TH TO 9TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Summer meeting in London. For programme see page 369.

MONDAY TO THURSDAY, JULY 7TH TO 10TH.

INSTITUTION OF SANITARY ENGINEERS.—Royal United Services Institution, Whitehall, London, S.W. 1. International Conference on Sanitary Engineering. For programme see page 713. 10 a.m. each day.

TUESDAY, JULY 8TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Thirtieth James Forrest Lecture, "Electrical Progress and its Unsolved Problems," by Professor Elihu Thomson. 8.30 p.m.

WHITWORTH SOCIETY.—Holborn Restaurant, London, W.C. 2. Summer meeting. Dinner. 6.30 for 7 p.m.

WEDNESDAY, JULY 9TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, London, S.W. 1. Conversazione. 8 to 11.30 p.m.

RADIO SOCIETY OF GREAT BRITAIN.—Institution of Electrical Engineers, Savoy-place, London, W.C. 2. Informal meeting. "The Manufacture of Condensers," by Mr. P. R. Coursey. 6 p.m.

THURSDAY, JULY 10TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Presentation of the Kelvin Medal, 1923, to Professor Elihu Thomson. 4.30 p.m.

KELVIN CENTENARY CELEBRATIONS.—Institution of Civil Engineers, Great George-street, London, S.W. 1. For programme see page 638. 4.30 p.m.

THURSDAY TO TUESDAY, JULY 10TH TO 15TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Visit of delegates of Overseas Technical Institutions. For programme see page 610.

FRIDAY, JULY 11TH.

KELVIN CENTENARY.—Connaught Rooms, Great Queen-street, London, W.C. 2. Banquet.

TUESDAY TO FRIDAY, JULY 15TH TO 18TH.

HIGHLAND AND AGRICULTURAL SOCIETY.—Edinburgh. Ninety-third annual show at Perth.

THURSDAY, JULY 24TH.

INSTITUTE OF COST AND WORKS ACCOUNTANTS.—Connaught Rooms, Great Queen-street, London, W.C. 2. Annual dinner. 7 for 7.30 p.m.

FRIDAY, JULY 25TH.

INSTITUTE OF COST AND WORKS ACCOUNTANTS.—Connaught Rooms, Great Queen-street, London, W.C. 2. Costing Conference. 11 a.m.